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## A WEEKLY JOURNAL OF SCIENCE

*"To the solid ground  
Of Nature trusts the mind that builds for aye"*—WORDSWORTH.

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### Science and Imperial Affairs.

SINCE the War, both Houses of Parliament and those members of the general public interested in Imperial matters have devoted more attention to the affairs of the five countries under British control in East Africa than to any other part of the British Empire except India. Numerous white papers on East Africa have been presented to Parliament in 1924 a special East Africa Committee was appointed, on which all three political parties and other interests were represented in the same year Mr Ormsby-Gore, Major Church, and Mr Linfield made a tour of the five countries and presented a long report to Parliament in 1925 in 1927 a further commission, to consider the possibility of the closer union of the territories, was sent out under the chairmanship of Sir Hilton Young. Following the publication of the still more voluminous report of that visiting commission, the Permanent Under-Secretary of State for the Colonies, Sir Samuel Wilson, proceeded to East Africa himself to discuss the recommendations of the Hilton Young Commission with the Colonial Governments concerned, and his report was presented to Parliament in July 1929. In June 1930, Lord Passfield, then Secretary of State for the Colonies, issued a "Statement of the Conclusions of His Majesty's Government in the United Kingdom as regards Closer Union in East Africa", and a memorandum on native policy and finally Parliament appointed a Joint Committee of both Houses to consider the Reports on Closer Union in East Africa and other relevant documents. The report of that joint committee was recently presented to Parliament.

The reports of the Ormsby-Gore and Hilton Young Commissions were the subject of editorial comment in *NATURE* at the respective times of their presentation to Parliament. The Ormsby-Gore Commission, which was primarily concerned with the economic development of East Africa, quite properly dealt with political questions only in relation to their effect on such development. It was a report in striking contrast with previous reports on Colonial matters because of the exceptional prominence it gave to the dependence of economic progress on the generous provision of education and medical services, the adequate provision of scientific and technical services, and the prosecution of scientific research in connexion with social as well as <sup>purely</sup> economic problems. It directed attention to the regrettable abandonment by the East African Governments of the once famous Amani Plant Research Institute, to the need for the creation of a central veterinary research station, to serve the five territories, the establishment and endowment of a central research institute for the investigation of human tripanosomiasis (sleeping sickness), the inauguration of a great campaign against tsetse flies directed by qualified scientific experts, the re-establishment of a geological survey department in Tanganyika and the establishment of a similar department in Kenya, the organisation of anthropological research, the more energetic prosecution of plant and animal breeding experiments by the various departments of agriculture, and a scientific and comprehensive survey of the lake and marine fisheries of East Africa.

That practically all the recommendations of the Ormsby-Gore Commission in connexion with these matters were acted upon within two years was due to the energy and enthusiasm with which Mr. Ormsby-Gore and Major Church applied themselves to the task of stirring the authorities at home and in the Colonies to the need for immediate action. The fact that neither the Hilton Young Commission nor the Joint Select Committee on East Africa has found it necessary to add any further suggestions for the furtherance of scientific research is eloquent testimony to the thoroughness of their original survey.

It must be confessed, however, that the various bodies representing the interests of science in Great Britain displayed a lamentable lack of appreciation of the fact that the Ormsby-Gore report provided them with an unusual opportunity to participate more energetically in framing an Imperial policy. At that time they could have

made statesmen and politicians realise that the scientific community ought not merely to be consulted by, but represented on, any and every committee set up by Government to consider any aspect of economic development at home or overseas. Incidentally, what is equally important, they could have insisted on their competence to appoint their representatives themselves, and not, as is the custom on those rare occasions when the Government does appoint a man of science on a committee, to have their representatives chosen for them by Government officials.

Since the scientific community in general has taken so little interest in the prosecution of research and the provision of essential scientific services in the Colonies, it is not surprising that successive Governments have ignored them when appointing committees to consider Colonial services and development. There is no representative of science on the Empire Marketing Board, and until recently there was no member of the scientific community on the Research Grants Committee of that body. The scientific interest was not represented on the Committee appointed in 1925 under Sir George Schuster to consider the allocation of the East Africa Development Loan which was recommended by the Ormsby-Gore Commission, although this Committee was dealing with grants for the establishment of research institutions and for *ad hoc* researches. The Hilton Young Commission of 1927, the terms of reference of which included the co-ordination of the scientific and technical services in East Africa, contained no scientific member, although the missionary societies were represented. The Labour Government ignored the scientific community in appointing members of the Colonial Development Advisory Committee, although this Committee had to consider schemes for the provision of scientific research. It is worthy of note also that the Labour Government, which appointed the Joint Select Committee of both Houses of Parliament on Closer Union in East Africa, deliberately excluded Major Church, its only representative in the Commons who had first-hand acquaintance with the territories under review, whose main contributions to the report of the Ormsby-Gore Commission had been the chapters dealing with medical and scientific research, and who could claim to represent scientific interests in Parliament.

The above list of Committees, appointed by various Governments during the past eight years, on which the scientific community should have been, but was not, represented, is by no means

exhaustive. It is long enough, however, to establish the fact that Governments will ignore scientific workers while the latter remain indifferent to the affairs of State, more indifferent, it appears, than any other section of the community, although statecraft is now mainly a question of making humanity fit for science, or at least of modifying the political and economic systems of the world to enable its inhabitants to enjoy the fruits of scientific endeavour.

That the scientific community is indifferent is borne out by the fact that on no occasion has it combined to protest publicly against the omission of its representatives from any of the important bodies enumerated above, all appointed to deal with subjects to which men of science could make important contributions, more authoritative and carrying far more conviction than if made by others with merely a vicarious interest in their work, and usually unable to appreciate the fact that the scientific outlook is even more important in dealing with Imperial or world problems than the mere application of the results of science to productive processes.

The question arises, however, are there many scientific workers themselves who are conscious of the significance of a scientific outlook as distinct from a scientific result? If there were many such, would it not be reasonable to assume that they would recognise this 'outlook' as the integrating force and create a unified representative body for the whole mass of scientific practitioners and believers in science in the British Empire? Such a body is obviously necessary if nations are to be encouraged to think scientifically. Unfortunately, the tendency towards specialisation, inevitable and of paramount importance for the advancement of scientific knowledge, has obscured the essential unity and the grander purpose of those trained in the sciences. This unity can be attained if the many specialist scientific and technical societies and institutions will recognise their limitations, and that as discrete fragments of the world of science they cannot hope to fulfil the nobler aim. They must join forces and create a strong body that can, a body the primary function of which is to inculcate a scientific outlook and promote the application of scientific method and results to national and Imperial affairs. This, in fact, is the avowed function of the British Science Guild, and there is little doubt that, with adequate support from the specialist scientific societies, such a body could get the respect for science which science deserves, and secure for science that representation in the councils of the nation which the nation and the Empire urgently need.

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### Hermaphrodites.

*Die sexuellen Zwischenstufen* Von Prof Dr Richard Goldschmidt (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 23) Pp x+528 (Berlin Julius Springer, 1931) 46 40 gold marks

IT is now eleven years since Dr Goldschmidt brought out the well-known volume of which an English translation appeared in 1923 as "The Mechanism and Physiology of Sex-Determination". The present work elaborates that section of his former book, which treated of what are generally termed hermaphrodites, a proper understanding of which is so essential to a full appreciation of the nature of sex itself. To that understanding no one has contributed more than the author, for it was through his remarkable researches on the races of the gipsy moth (*Lymantria dispar*) that the problem of the intersex has crystallised out of that vast conglomerate of miscellaneous knowledge comprised under the heading of sex.

Goldschmidt's interpretation of the phenomena with which he deals is, of course, based upon the fact that sex, like any other hereditary character, is normally determined by specific genes which are definitely located in the chromosomal material. Where the sexes are separate the difference between them is determined by a single gene, or by a gene complex behaving normally as one, whence it follows that in the ordinary way the sexes are produced in approximately equal proportions. Such equality may be upset in various ways—for example, by differences in viability at various stages in development, by the association of a lethal factor with one sex or the other, and by other means. In such cases, however, in spite of the upsetting of the numerical balance between the sexes, their physiological distinctness remains unaffected, and the ultimate result is normal males and normal females.

Such a scheme, based on the ordinary conceptions of Mendelian heredity, offers a satisfactory explanation of most of the phenomena connected with the inheritance of sex. But it does not explain the hermaphrodite. As already stated, attention was first focused on this problem by Goldschmidt's work with the gipsy moth, a species in which the form and colour of the female is very distinct from that of the male. An amateur breeder, Herr Brake, pointed out that in certain crosses between the European gipsy moth (*L. dispar*) and a form from Japan (var *japonica*) there appeared forms more or less intermediate in sex characters. He called them gynandromorphs, and for some years

found a ready sale for them among those who collect Lepidoptera in the spirit in which others collect postage stamps. In 1910 Goldschmidt started his remarkable analysis of the case—an analysis spread over twenty years and involving visits to Japan in connexion with the determination and crossing of the geographical races, morphological and physiological investigations, and the critical breeding of tens of thousands of moths. The gist of his interpretation is as follows.

As in other Lepidoptera, the male is the homogametic sex with two sex chromosomes carrying a sex factor, the female carrying but one. In other words, the male is homozygous for a factor,  $M$ , which stimulates the male part of the genital complex, while the female is only heterozygous for this factor. In the cytoplasm, on the other hand, is something which stimulates the production of the female part of the genital complex. This substance ( $F$ ), being cytoplasmic, is maternally transmitted, and all the offspring receive an  $F$  of the same quality as that of their mother. In an ordinary race, such as the European *dispar*, the genetical constitution of a male is  $FMM$ , and that of a female  $FM$ . The female-producing tendency of the cytoplasmic  $F$  can be overcome by two 'doses' of  $M$ , but not by one dose. Hence the production of normal males and females in equal numbers, and of normal males and females only, and this is true for each given pure race of *Lymantria*. The explanation of the appearance of intersexes on crossing different races turns upon the assumption that the intensity of the action of  $F$  and  $M$  differs in the different races. Thus in *japonica* both  $F$  and  $M$  are 'stronger' than in *dispar*, that is, they exert their influence earlier in the course of development; conveniently they may be denoted as  $F_s$  and  $M_s$  to distinguish them from the  $F$  and  $M$  of *dispar*. The cross between *dispar* female ( $FM$ ) and *japonica* male ( $F_sM_sM_s$ ) results in two kinds of individuals of the constitution  $FMM_s$  and  $FM_s$ , respectively. The former are normal males in appearance, but the latter are intersexes. For the 'strong' male factor ( $M_s$ ) from *japonica* partly overrides the female-producing cytoplasm ( $F$ ) from the 'weaker' parent which is inherited maternally by all the offspring from this cross. From the reciprocal cross, *japonica* ♀ ( $F_sM_s$ ) × *dispar* ♂ ( $FMM$ ) only apparently normal ♂♂ ( $F_sM_sM$ ) and normal ♀♀ ( $F_sM$ ) are produced. For a weak ( $M$ ) and a strong ( $M_s$ ) male factor together can override the strong cytoplasm ( $F_s$ ). But in  $F_2$  from this cross appears the fresh combination  $F_sMM$ , which must be regarded as the genetical constitution

of the so-called male intersexes that appear in this generation. For two doses of the weak  $M$  cannot completely override the strong  $F_s$ .

When in Japan, Goldschmidt distinguished eight races of *Lymantria*, and an elaborate series\* of breeding experiments enabled him to arrange them in a series of decreasing 'strength'. The difference between the extremes of this series was greater than between European *dispar* and the Japanese race used in the earlier work. Indeed, it was so great that when the weakest was used as the mother and the strongest as the father, males alone resulted. Subsequent experiment showed that while about half of these males were chromosomally males ( $FM_sM_s$ ), the rest were really females ( $FM_s$ ) in which the male factor ( $M_s$ ), introduced from the strong race, was so strong as to override entirely the cytoplasmic  $F$  of the weaker, and to cause a complete reversal of the sex as judged by chromosomal constitution. Conversely, Goldschmidt was also able to obtain from these two races insects of the constitution  $F_sMM$ , individuals chromosomally males but in appearance females owing to the complete overriding of the weak  $M$  by the strong  $F_s$ . Through crosses between the different races every grade of intersex could be obtained, but with given races the grades could be predicted even in highly complex crosses. Although the 'strength' or 'valency' of the sex factor differed for each race, it was in each race fixed, and Goldschmidt suggests that this fixity is at bottom quantitative, depending upon definite amounts of the sex-determining material present in any case. He supports his views by reference to the triploid intersexes in *Drosophila*, which cytological work has shown to depend upon the relative proportion of X chromosomes and autosomes.

In these cases among insects, to which may perhaps be added a few more among other invertebrates, the intersexuality depends upon the constitution of the zygote as determined at fertilisation. Goldschmidt then proceeds to consider a group of cases, also among arthropods, where parasitic infection by another arthropod may lead to partial, or even complete, reversal of sex, and he argues that this group of cases may also be brought into line with the conceptions derived from the *Lymantria* case. Perhaps the best known of this group is that of the crabs, in which infection by the rhizocephalan *Sacculina* leads to the male assuming in varying degree the female type of abdomen and appendages, and even developing ovarian tissue after the loss of the parasite. Goldschmidt suggests that the action of the parasite may be to upset the

normal balance between the *F* and *M* substances, either by destroying one or by increasing the other. There is, however, a peculiarity about this group of cases in that, with the possible exception of the stylipised *Andraena*, the intersex is always the result of the male becoming more or less feminised. Such changes as occur in the female may be regarded as merely an arrest in the normal development. The case for what may be called 'reciprocal reversal' rests upon the colour changes in the clypeus of *Andraena* in different species, and one would like to know more about the genetics of this character before accepting Goldschmidt's view.

The so-called parasitic castration group shows, however, that the sexual characters inherent in the zygotic constitution of the individual may be largely modified by influences extraneous to the cell. This is of course markedly the case for the vertebrates, where the development of sexual characters is largely dependent upon the hormones or internal secretions developed by the gonad, and by other glands as well. The wide difference in this respect between arthropods and vertebrates is well shown by castration experiments. In *Lymantria*, as Meisenheimer showed many years ago, castration in the larval stage, whether simple or followed by transplantation of the gonad of the opposite sex, has no effect either on the sexual apparatus or on the secondary sexual characters. The turning-point is already past and the sex irrevocably determined before the operation has become a practical possibility. In vertebrates, however, as is well known, castration produces marked changes, the magnitude of which is to some extent dependent upon the stage at which the operation is performed. In general, it may be said not only to arrest the development of the sexual apparatus itself, but also to inhibit in many cases the appearance of secondary sexual characters. The normal condition may, however, be restored by implantation of a gonad of the same sex. Even more remarkable is the result of implanting a gonad of the opposite sex, for in this way a female may be caused to develop many of the characters of the male, and vice versa.

Goldschmidt's book provides an excellent and critical account of all the more important work that has been done along these lines. He points out, too, that although the sexual complex in vertebrates is so sensitive to hormonal secretions, we can nevertheless distinguish certain cases in which an intersexual condition must be regarded as directly dependent upon the zygotic constitution of the individual. The clearest cases are in the goat and the pig, particularly that of the remarkable New

Hebridean swine described by Baker, and Goldschmidt is justified in pointing out the parallel which they afford to his *Lymantrias*. For there can be little doubt that here also the peculiarities are hereditary, and due primarily to zygotic constitution. A valuable feature in Goldschmidt's book is his review of intersexuality in man, a subject hitherto much confused by the speculations of medical men who lack genetical training. Though most of the phenomena can be brought into line with those exhibited by the pig and the goat, there are certain others that are very puzzling. Among these are gynæcomasty and homosexuality, and Goldschmidt is inclined to look for an explanation in a defect of some endocrine secretion rather than in zygotic constitution, the criterion of intersexuality proper.

The last part of the book is devoted to a consideration of gynandromorphs as distinct from intersexes. This important distinction we owe to the author himself, who once aptly described the former as hermaphrodites in space and the latter as hermaphrodites in time. For, whereas the latter are sex compromises dependent upon the relative speeds at which the *M* and *F* substances get to work, the former are merely mosaics of purely male and purely female tissues. The formation of such a mosaic generally depends upon the elimination of a sex chromosome at some stage or other in cell division. Thus, if a fertilised *XX* egg of *Drosophila*, which would normally develop into a female, drops out an *X* from one of the two cells resulting from the first division, and if then development proceeds normally, one half of the resulting insect will be *XX* and the other half *X* in constitution. Hence one half of the body will be female and the other half male, that is, the insect will be a bilateral gynandromorph. But polyspermy or binucleate eggs may also be sources of gynandromorphs, and the reader will find a clear exposition of the various possibilities. Of great interest, too, is the account of the hereditary nature of gynandromorphs in the silkworm, the working out of which we owe to the author.

Taking it altogether, the book gives what is undoubtedly the fullest and most lucid exposition of the subject that at present exists. On some points the reader may disagree with the author's views, but the position of those with whom he may not hold is always fairly met, however sharply criticised. As befits a master of his subject, the dominant idea throughout is synthesis, the attempt to weave into a coherent whole a great mass of facts, using *Lymantria* as the guiding thread. The result is a



valuable and highly stimulating book, admirably documented on an excellent bibliography. On one point alone is it possible to quarrel with it. For, though well produced and fully illustrated, the price appears to us to be exorbitant. One can only hope that this will not restrict the sale of a work that in the interests of knowledge deserves a wide circulation.

### Comparative Psychology in the Field.

*The Intelligence of Animals. Studies in Comparative Psychology.* By Frances Pitt. Pp 320 + 46 plates (London: George Allen and Unwin, Ltd., 1931) 15s net.

FOR many years Miss Frances Pitt's books have adorned the front rank of observational studies in animal behaviour. One was always sure of finding fresh material, as reliable as it was interesting. Gradually, however, the gifted observer has become more frankly reflective, as in her "Animal Mind", and now we have a record in which the inferences are definite contributions towards a solution of some of the deeper problems of biology. The outcome is a psycho-biological picture, convincing us afresh that we cannot describe the ways of animals, or account for their survival, unless we do justice to their 'mentality', including in that term all the creature's mental acquirements, characteristics, and predispositions. That intelligence and parental affection may have survival value will be admitted by most open-air naturalists, but Miss Pitt shows that we must also take account of subtler qualities, such as tameness and confidingness, wariness and shyness, a desire to be left alone, and a liking for neighbours. Inferences cannot, of course, claim the cogency of observations, but Miss Pitt states a strong case for the validity of psycho-biology, stressing the mind-body as much as the body-mind. Even temperament may have survival value in wild Nature.

The first studies have to do with call or decoy ducks, a domesticated race of mallards, which show how the 'wild' may give rise to the 'tame' and lose some of its most characteristic features, such as monogamous and migratory habits. The wild mallard is not turned into the tame decoy, but a selection of stay-at-home individuals, sustained for generations, results in the elimination of the wandering and migratory impulse. The tame type is in most cases quite content to stay all the year round upon two or three small pools, despite the fact that it has wings at its command and might wander far if it pleased. "The strict monogamy

that characterises the mallard suffers in the case of the decoy duck from the deteriorating influences of man and domestication." The duck remains faithful, but the drake generally makes use of his opportunities to 'transgress'—a term which is not, of course, meant to imply an avian code of morals in the strict sense.

In the second set of studies, centred in the semi-domesticated peafowl, Miss Pitt has many observations of great interest. It looks as if the peacock's display is in the main an expression of exuberant sex-excitement. He may show off to ducks, the hen is often bored by the display, there is little to suggest that the cock has any inkling of his own splendour. As the display involves considerable strain, as in rattling the quills, we search for some other utility if we abandon (as we are not yet prepared to do) the theory that it infectiously rouses the interest and sex-excitement of the hen. Miss Pitt interprets its biological function as "probably that of advertisement, so that the female may know the whereabouts of the male, and especially her male." For the hens are faithful to their chosen polygynous cock.

Very important, as it seems to us, is the conclusion that the showing-off attitude, with erection of the tail-coverts, is the same in the tiny chicks, in the young birds of both sexes, in the old hens, and in the adult males. "Under stress of emotion they all behave in the same manner." In other words, the sex-urge utilises and emphasises a general gesture. Chicks not ten days old, excited by the sudden appearance of a pet raven, erected their diminutive tail-coverts just as did their strutting sire.

Another observation on young peafowl is very interesting: that when they lost their mother, about three weeks after hatching, and were pining, they took courage when the hurriedly stuffed body was brought on the scene, and behaved to it, doubtless on the strength of established associations, exactly as if the mummy, which became flat and loathsome, were actually alive. There are many similar treasures in this delightful and reliable book, but we cannot do more than indicate the general nature of the observations.

The third part of the book deals with the horse, cow, sheep, and pig, and readers of Miss Pitt's "Animal Mind" will not be surprised that her estimate of the horse's mentality is lower than that usually approved, while her estimate of the other three ungulates is higher. Scientific and impersonal as we try to be, we cannot, while comparative psychology remains relatively inexact, readily get away from our individual experience of individual

animals Thus we personally think that the horse's intelligence is much greater than Miss Pitt can see her way to allow

The fourth section of the book is devoted to dog and cat, and it pricks some bubbles of reputation We breathe more freely when we discover that the dog still remains worthy of being called intelligent, while the cat's mind is left as an elusive mystery behind its inscrutable green eyes

The fifth part deals with the fox, as a type of the thoroughly wild mammal As a sample of the careful phrasing that marks the whole book, we quote Miss Pitt's verdict on the fox

"My opinion of the average fox is that it ranks high in the scale of intelligent mammals, but that much of its conduct is regulated by inherited response, though such instinctive aptitude is ever qualified by experience, by which the fox profits to a marked degree, its very educability proving its intelligence If not so super-intelligent as some sporting writers and the sentimental story-writers would have us believe, it is equally far removed from the thing of merely automatic responses that the behaviourist school make of our mammals"

This is well and wisely said, yet perhaps there is something to be gained by keeping the word 'conduct' for those rationally or ethically controlled human activities which rise above 'behaviour'

The sixth section is perhaps the subtlest in the book, and thus the least convincing It takes lemming, crane, and Skomer vole as illustrations of the thesis that temperament has survival value in the struggle for existence The lemming's behaviour is characterised by the temperamental quality we call tameness, which is made possible by certain compensatory advantages, such as the habit of burrowing beneath the enveloping mantle of snow and the capacity for very prolific multiplication The apparently contradictory intimidating display in a tight corner is the outcome of a mixed emotion of fear and anger It is a useless and often risky form of 'bluff'

Why is this delightful book of high scientific value? Because it is a vindication of the importance of the mental factor in determining the status of an animal, its survival and distribution—a vindication by an expert observer who is aware of the many pitfalls of psycho-biological interpretation We quote her concluding sentence

"Every bird, beast, and lower creature supplies us with a problem of the highest interest—namely, the elucidation of the factors that control its position in the web of life, of which factors those governing behaviour are the most vital, especially the mind that governs purposive action"

J A T

## The Science of Oceanography.

*Oceanography its Scope, Problems, and Economic Importance* By Henry B Bigelow Pp vii + 263 (Boston and New York Houghton Mifflin Co., London Chapman and Hall, Ltd., 1931) 12s 6d net

IT is barely sixty years since H M S *Challenger*, by her exploratory voyages round the world, built the foundations upon which the modern science of oceanography has grown up For centuries man had roamed the seas and charted their boundaries, looking for new land or trade routes rather than for a knowledge of the sea itself Exploration showed that less than one-third of the earth's surface is dry land, now that most of this has been mapped, attention is being turned more and more to the remaining two-thirds, which forms a world of its own, and by the very reason of its vastness holds the key to many of the secrets of land phenomena.

The geologist must look to the nature of the ocean bed for help in the solution of some of the most pressing questions in the study of the earth's crust This involves a knowledge of the sediments now being deposited on the sea floor, of the rate of their deposition, and the question of their subsequent solution These phenomena are so intimately bound up with the physics, chemistry, and biology of the sea that they emphasise at once the unity of oceanographical science The presentation of the whole story of the course of events at the present day would throw much light on the past history of our sedimentary rocks The study of dynamic geology further demands a more complete knowledge of the contours of the great ocean beds, combined with gravity measurements to determine the density of the earth's crust

To the biologist the sea represents a world in itself, in fact, once the excitement of research on life in the sea has gripped the beginner, he is liable to forget that a zoology of animals on dry land exists This is pardonable, when it is realised that there are probably few problems on land that have not their parallels in the sea, in which all life was evolved Owing to the peculiarity of the environment also, the very fundamentals of life appear to be best open to attack, for it is in the sea that life is at its simplest and the living organism is least cut off from its surrounding medium by the development of protecting structures It is for this reason, perhaps, that the marine biologist at once feels that any observations he makes are sadly lacking if he does not possess the necessary physical and chemical

data of the environment. For the sea is a whole, and must be treated as such for a correct understanding of the manifold problems that surround us. Where the whole water mass is in constant circulation, changes in one locality may be far-reaching and make their effects felt in the remotest regions. Perhaps nowhere is this more obvious than in the study of the great fluctuations in marine life, the ultimate effects of which are brought home to us in the fisheries from which we draw so much of our food supply.

We have travelled a short way only along the road of oceanography, but everywhere the signposts point to the need for networks of fuller and more complete observations over wide spaces and over long periods of time. Such need is, perhaps, most outstanding in the realm of physical and chemical oceanography, where the actual movements of the water masses are concerned, movements which, apart from their enormous biological implications, must have a bearing on meteorology and on navigation. It awaits to be shown whether correlation can be found between the conditions of water masses in one region and later meteorological conditions in far distant localities, a problem that alone involves many years of labour. But if such correlation should be found, its great economic value in the possibilities of long range weather forecasting is obvious to all.

Oceanographical investigation is expensive, entailing as it must do the running of a well-found ship. The solution of many of the most pressing problems is not insurmountable with mechanics to our aid, and here again the building and elaboration of effective apparatus is always expensive. For these reasons, with few exceptions, most schemes of research have been State-aided, and apart from the great exploratory voyages, the ultimate assistance of the fishing industries or the safeguarding of navigation have been held up as the main ends in view.

Last summer, however, one of the finest private marine institutions opened its doors at Woods Hole, alongside the two well-known existing laboratories. As a true marine laboratory, it has as its object the advancement of any knowledge that can be gained from an investigation of the sea. Operating from the laboratory is an ocean-going research vessel, the *Atlantis*, which has already completed her maiden voyage across the North Atlantic Ocean. The institution, which has been fully endowed by the Rockefeller Trust, is thus in a position to carry out a continuous study of the sea unhampered by the desire for immediate econ-

omic return for knowledge gained. The Director of the Woods Hole Oceanographical Institution, Prof. Henry B. Bigelow, has brought together in a masterly manner the present position of oceanographical research and its implications. One may conjecture that this report, which was laid before the National Academy of Sciences, was in no small degree responsible for the birth of the Woods Hole Institute. In the author's words, the book "is in no sense a text-book or a compendium of oceanographic knowledge." It does, however, very adequately lay before us some of the many problems still awaiting investigation in the science of oceanography, and as such deserves to be read by the research worker and the student.

F. S. RUSSELL

### Short Reviews.

- (1) *Dorure-encadrement technique des différents genres de gravure, comment reconnaître les fausses estampes et les faux papiers*. Par A. Broquelet (Bibliothèque pratique de l'amateur) Pp. 95 (Paris J.-B. Baillière et fils, 1930) 6 francs.
- (2) *Décoration des verres, émaux, céramiques*. Par Prof. Suzanne Zaborowska (Bibliothèque pratique de l'amateur) Pp. 90 (Paris J.-B. Baillière et fils, 1930) 6 francs.
- (3) *A Treatise on the Air Brush with Progressive Lessons*. By Samuel W. Frazer and George F. Stine. Pp. x+203 (London Chapman and Hall, Ltd., 1930) 12s. 6d. net.

THE first two works form a portion of a library for amateur craftsmen, but being written by cognoscenti, they should prove welcome to others also. (1), in successive chapters, deals with a brief historical survey, modelling, moulding, pyrography, adhesives, methods of engraving, lithography, photography, protecting engravings, framing, watermarks, mounting and wood gilding. In the space allotted are provided a large amount of useful information and many appropriate diagrams and illustrations, two of the latter (on pyrography) being from sketches by the writer of (2), which deals with a most interesting branch of art. But this manual is less satisfying than (1), for there is too much vapouring and too little practical exposition. The chapters relate to decoration of glass of various kinds, enamels and ceramics. Stained and leaded glass are well treated. "Nous avons expliqué les différents procédés" (p. 65) is not self-evident. The writer is a mistress at her craft and has a vigorous stroke for illustrations; she shows vividly how to adapt natural to conventional treatment. Special mention may be made of the stork (Fig. 25) and the strawberry leaf (Fig. 49). The third book is a very masterly exposition of that modern tool, the air-brush. The literary style is unexceptionable, the information direct and well balanced, and the illustrations as effective as American work is apt to be. There is

no doubt that the use of the air-brush can be well learnt from this treatise. There are, however, many who would still prefer the older method of brush treatment  
P L M

*Applied Mathematics for Engineers* By T Hodgson Vol 3 *Differential Equations with Applications* Pp viii + 320 (London Chapman and Hall, Ltd, 1931) 13s 6d net

FOLLOWING the very lucid and interesting application of the calculus to dynamics, given in vol 2, Mr Hodgson has produced an excellent sequel in the present volume. The course has been thoroughly well planned and clearly dealt with. The subject matter embraces ordinary equations, simultaneous linear equations, partial differentiation and equations, with two good chapters on double and triple integration and spherical trigonometry.

The theoretical aspect has been well developed, though not, perhaps, with the strict rigour so dear to the pure mathematician, for this would be quite out of place in such a book. Nevertheless, just as much theory as is essential to the intelligent understanding of fundamental processes is given, so that the engineering student need no longer be a mere seeker after ready-made formulæ, but may acquire an efficient mathematical equipment by which he can be certain that his calculations are based upon a sure foundation. The chapter on partial differentiation is a striking example of the skill by which the author develops the theoretical basis. An index is unfortunately omitted from the *y* in the sixth line from the bottom of p 80.

Not the least interesting part of the book is its manifold applications. These are carefully selected and demonstrated with great clarity. Beginning with the usual deflexion of beams, the author leads on to thermodynamic problems, harmonic analysis, and alternating currents, which are dealt with by vectors, by complex quantities, and by the Steinmetz operator. Numerous exercises for the student are also provided and these have evidently been carefully selected so that few problems of purely academic interest have been included.

(1) *The Macmillan Table Slide Rule* By Prof J P Ballantine Pp 4+4 slides+4 plates (New York The Macmillan Co, 1931) 2s 3d

(2) *Natural Trigonometric Functions to Seven Decimal Places for every Ten Seconds of Arc, together with Miscellaneous Tables* By Howard Chapin Ives Pp vi + 329 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1931) 45s net

(1) FOUR plates contain five figure tables of  $10^\circ$ ,  $10^{10^\circ}$ , arc sin  $10^\circ$ , arc tan  $10^\circ$ . The four slides consist of tables of  $10^\circ$ ,  $10^{-2}$ ,  $10^{22}$ . By aligning the slides on the appropriate plate all the usual slide rule calculations which depend on log  $x$  and log log  $x$  can be performed. The alignment needs great care if a wrong reading is to be avoided.

(2) The main table gives on 270 pages natural sines, cosines, tangents and cotangents for every

10 seconds of arc, each page covering a range of 10 minutes of arc. The functions corresponding to an integral number of minutes are more boldly printed. The effect is pleasing and makes the table convenient in use. First differences and proportional parts are also given. The remainder of the book contains various subsidiary tables connecting chords, arcs, radii and central angles in a circle, adapted to the use of railway and road engineers. The book concludes with trigonometrical formulæ and an explanation. The origin of the values in the main table is not mentioned. The author states that the manuscript was twice checked and the proofs read four times and by three persons. The binding is strong and the printing is excellent  
L M M-T

*Motor Benzole its Production and Use* By W H Hoffert and G Claxton Pp xxi + 689 (London The National Benzole Association, 1931) 25s

FARADAY discovered benzene, Perkin made synthetic dyes from aniline, it was found to be an easy step by nitration and reduction from benzene to aniline. Benzene became ennobled, the world preened itself in a coat of many colours, and birth was given to the great dyestuffs controversy which, perhaps, has now found an honourable senescence amongst the acts in the Expiring Laws Continuation Bill. Now a new child has been born, motor benzole, with a more aristocratic name. After one or two false starts in 1903 and 1907, it became an established fact as a fuel in 1913, and now National Benzole pumps are to be seen every few hundred yards on our highways. The proportion of the total production used—Prof H E Armstrong terms it misused—by the motorist increases each year, and considerably exceeds that required by the dye-maker, who, however, has to pay the higher price based on the fuel value of the spirit.

Benzole is extracted in gas works and coke ovens, but nothing like the total quantity possible is recovered. Some day a commercial synthesis of benzene will be achieved. It takes a book of more than 600 pages, including 120 tables, to tell us about motor benzole from every aspect of practice and theory. It is authoritative since it is prepared under the auspices of the National Benzole Association, which has established a highly competent research department.

*The Problems of Evolution* By Prof A W Lindsey Pp xiii + 236 (New York The Macmillan Co, 1931) 8s 6d net

THE object of this essay is to show how impossible it is to separate heritage and environment in the study of evolution. This involves the author in a discussion of the inheritance of acquired characters, and references are given to much recent research. The limitation in its application to the methods of evolution lies in the difficulty of associating the responses of somatic structures with the germ cells. The book will be useful to teachers and students of biology for their lighter reading. They must be critical, and they should try some experiments for themselves.

## Scientific Centenaries in 1932

THE value of the commemoration of the centenaries of notable men of science, of famous institutions, and of important discoveries, was demonstrated in many ways in 1931. The various celebrations not only gave opportunities for recalling great achievements but also provided occasions for reviewing the progress made in scientific research and its application to industry, and for stimulating public interest in modern developments. But apart from any direct gain which arises from such celebrations, it is only just that tribute should be paid to the memory of those who in the past have added to the spread of natural knowledge.

Foremost among the centenaries which fall within the year 1932 is that of Sir William Crookes, who was born on June 17, 1832. From the time of his discovery of thallium in 1861, until his death in 1919, he was in the front rank of investigators, while from the day he first published the *Chemical News* in 1859, he gradually attained to the highest eminence as a leader of scientific thought. His presidential address to the British Association in 1898 will long be remembered, while his name is to be found among the Copley medallists and the presidents of the Royal Society.

Born three months before Crookes, the eminent French man of science, Charles Friedel (1832-99) was both chemist and mineralogist. He assisted to found both the French Chemical Society and the French Association for the Advancement of Science and was the successor of Wurtz at the Sorbonne. Another chemist, born in 1832, who achieved distinction was Walter Weldon, who from journalism turned to scientific studies, and by his introduction of the manganese recovery process in the manufacture of chlorine, cheapened, as Dumas said, "every sheet of paper and every yard of calico throughout the world."

To the year 1832 also belong the names of Cailletet, König, Varley, Wimshurst, and Sir Charles Bright. Louis Paul Cailletet (1832-1913), one of the greatest ironmasters of France, in 1877, at the same time as Pictet, liquefied oxygen. He has been called the 'father of modern cryogenics'. Rudolph König (1832-1901), a German instrument maker of Paris, was well known for his researches in acoustics, James Wimshurst (1832-1903), the Board of Trade ship surveyor, built influence machines which did much to revolutionise the science of static electricity, Samuel Alfred Varley (1832-1921) was the inventor of the compound-wound dynamo, while Sir Charles Bright (1832-88) will always be remembered as a pioneer in submarine telegraphy. He was only twenty-four years of age when, in 1856, he joined with Brett and Cyrus Field in planning the project for the first Atlantic cable.

To these names may be added those of Nicolas August Otto (1832-91), originally a commercial traveller, who is remembered to-day for his outstanding work on the internal combustion engine, Gustave Eiffel (1832-1923), whose great tower was

but one of many notable civil engineering works for which he was responsible, Alexander Lyman Holley (1832-82), "foremost among those whose genius and energy established in America and improved throughout the world the manufacture of Bessemer steel", and Octave Chanute (1832-1910), another engineer, who became a pioneer of gliding and whose "Progress in Flying Machines" published in 1894 is a mine of information on early aeronautics. Chanute was born in Paris, but was taken at the age of six to America, where all his work was done.

The following were also born in 1832. Henry Seebohm, author of the "History of British Birds and their Eggs" (4 vols, 1882-85), Sir William Turner, formerly professor of anatomy in the University of Edinburgh and president of the British Association at the Bradford meeting in 1900, and Sir Edward Burnett Tylor, for whom a professorship in anthropology in the University of Oxford was instituted.

The losses in the ranks of men of science by death in 1832 were severe. Especially so was this the case in France, where an epidemic of cholera raged, which led to the death of eighteen thousand persons in Paris alone. Among the victims of the epidemic were Sadi Carnot (1796-1832), immortalised by his essay, "Reflections sur la puissance motrice de feu", Baron von Zach (1754-1832), the Hungarian astronomer who from 1791 directed the observatory at Seeberg, and General Berge (1779-1832), of the French artillery, one of the earliest students at the École Polytechnique, who drew the plates for Monge's "Géométrie descriptive". The Marquis de Jouffroy D'Abbans (1752-1832), the French representative among the pioneers of the steamboat, and Baron de Sané (1755-1832), the eminent naval constructor, "le Vauban de la Marine", who built the historic *Orient*, also died in 1832, as likewise did the veteran chemist Chaptal (1756-1832), and the great naturalist Cuvier (1769-1832). Both these distinguished men played a part in public affairs under Napoleon, and Cuvier, as permanent secretary of the Paris Academy of Sciences from 1803 onwards, was one of the most prominent among the brilliant group of French men of science of that time.

To these names must be added that of the young French mathematical genius, Evariste Galois (1811-1832), who was killed in a duel and whose tragic biography has been written by Dr G. Sarton, and also those of the Italian astronomers and ecclesiasts, Angelo Cesaris (1750-1832), and Barnaba Oriani (1752-1832), who made Milan Observatory famous, of Stephen Groombridge (1755-1832), the London merchant who compiled a star catalogue and helped in founding the Royal Astronomical Society, and that of Sir John Leslie (1766-1832), the successor of Playfair and the predecessor of J. D. Forbes in the chair of natural philosophy at Edinburgh.

Bicentenaries are naturally less numerous than centenaries, but many are of considerable interest



In 1732, for example, both Maskelyne and Lalande were born. For forty-six years Maskelyne (1732-1811) was Astronomer Royal, and to him was due the founding of the *Nautical Almanac*. Lalande (1732-1807) also has many claims to our homage. Indefatigable in his exertions on behalf of science, by his lectures at the Collège de France he gained for astronomy an unexampled popularity, and one of his books was called "the great newspaper of astronomy". It was to Maskelyne that Herschel first communicated the discovery of the heavenly body now known as the planet Uranus, but it was Lalande who wished to call it Herschel, a name it was actually known by for some years. Another astronomer born in 1732 was David Rittenhouse (1732-96), who succeeded Franklin as president of the Philosophical Society of Philadelphia and was among the first to welcome Priestley to America. The French mineralogist, Gabriel Jars (1732-69), the compiler of the "*Voyages métallurgiques*"; Alexander Cronstedt (1732-65), the Swedish discoverer of nickel, were also born the same year, as also was Richard Arkwright (1732-92), the greatest of the founders of our textile industry.

Carrying the survey a hundred years still further back, in 1632 Sir Christopher Wren and the great Dutch naturalist Leeuwenhoeck were both born, while that year saw the deaths of several mathematicians who were contemporaries of Kepler, Napier, and Galileo. The two British mathematicians, Thomas Allen (1542-1632) and Nathaniel Torporley (1564-1632), died in September and April respectively; the Dutch mathematician, Albert Girard (1595-1632), who collected and published the works of Stevinus and discovered various properties of spherical triangles, died in December; Lansberg (1561-1632), of Belgium, both mathematician and astronomer, whose tables were used by Horrocks, died in November; Christopher Borrus (1583-1632), of the Society of Jesus, who travelled to the Far East and in his charts of the Atlantic and Indian Ocean anticipated some of the work of Halley, died at Rome in May 1632, while another mathematician who died that year was Jobst Bürgi (1552-1632), whose system of anti-logarithms was worked out by him independently of the contemporary discoveries of Napier.

### Hydro-Electric Power Development in the Pyrenees.

By Dr. BRYSSON CUNNINGHAM.

AN interesting and efficient system of electric power generation and distribution, serving the Southern Railway of France (Chemins de Fer du Midi) and a number of important regional industries, has been developed, mainly during the past decade, from the natural water resources of the western Pyrenees. During a recent tour in southern France, I was afforded, through the courtesy of the Midi Company, an opportunity of visiting several of the generating stations, and the following is a brief description of the salient features of the undertaking, known as the Union des Producteurs d'Électricité des Pyrénées Occidentales (U.P.E.P.O.), which controls more than half a million horse-power, say one-fourth of the total water power developed in France, as registered at the end of 1930. The gross potential water resources of that country are estimated to be between nine and ten million horse-power.

The Pyrenees, forming, as is well known, the frontier barrier between France and Spain, with a length of about 240 miles between Cape Cerbera on the Mediterranean littoral and the south-eastern corner of the Bay of Biscay, apart from their engaging geological structure, present an interesting hydrographic feature, in that there is a marked difference in the rainfall and snowfall between the eastern and western halves of the chain, the quan-

tity being much greater in the west. I certainly acquired a confirmatory impression of the western abundance during three consecutive days spent in the neighbourhood of Pau in September, when the rainfall was almost incessant and its intensity surprising. The notable absence of glaciers in the



FIG. 1.—Cirque de Gavarnie.

eastern Pyrenees is accounted for by the insufficiency of the falls of snow for their formation. Obviously then, the great preponderance of moisture in the centre and west has marked out this region as a suitable area of exploitation for the development of hydro-electric power, and it is within the limits of the latitude of Oloron in the west and the



Val d'Aran in the east that the leading stations of the U.P.E.P.O. are located.

From the hydrographic point of view, several other characteristic features of the range lend themselves admirably to water-power development. Despite the general absence of great lakes, such as those in the Alps, there is a number of natural

stepped series, and two detached and isolated insulations. The chain lies in the upper valley of Ossau and commences at summit level with a source in the lake Artouste, a deep basin situated near the frontier line with its natural surface at a height of 1968.6 metres above sea-level. By means of a dam, the depth of water has been increased by 25 metres so as to form a reservoir with a capacity of 25 million cubic metres. From the lake a tunnel through the granite rock, 8.5 km. in length and about 6 ft. in diameter, conducts the water to a point just above the station of Artouste, which is entered by means of three pressure tubes under a gross head of 758 metres. The diameter of the tubes gradually decreases from 800 mm. to 600 mm. The flow actuates three Pelton wheels, each of 10,000 horse-power, coupled to three C.E.F. alternators of 7000 kw. capacity.

After passing through the Artouste Station, the water is received into two basins, each of 95,000 metres capacity, in succession, forming a working reservoir for the next station below at Miègebat, distant about 7.6 kilometres (Fig. 2). These basins also receive direct the waters of two mountain streams, or gaves: the Gave de Bious and the Gave de Brousset. The combined supply enters the Miège-

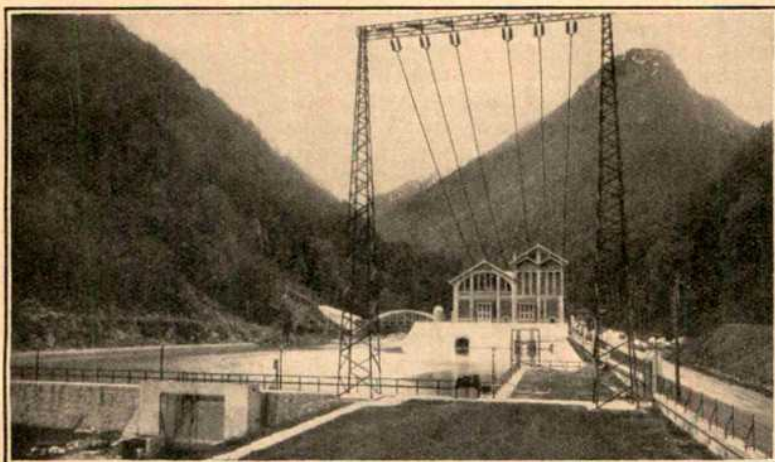


FIG. 2.—Miègebat generating station. The pipe lines are to the left and cannot be seen in the photograph. They enter the station across the bridge in the background.

basins of moderate extent which have been adapted as storage reservoirs for a working or a reserve supply of water, possessing potential energy of high value. In addition, waterfalls are numerous and lofty, being surpassed in Europe only by those of Scandinavia. The highest is the celebrated Cascade de Gavarnie with a fall of 1515 ft. The mountain streams or torrents which give rise to these falls are known locally as 'gaves'.

It is a curious feature of the topography of the Pyrenees that the upper ends of the valleys frequently expand into gigantic arcs of circles surrounded by towering, precipitous cliffs, crowned by snow and ice. These enlargements are designated 'cirques'. The most notable is the Cirque de Gavarnie at a height of 5000 ft. above sea-level, about a mile and a quarter in diameter, with rugged sides several thousand feet high, scored and intersected by hundreds of silvery cascades, including the Cascade de Gavarnie mentioned above (Fig. 1).

The U.P.E.P.O. came into existence in the early part of 1923, with the object of utilising to the best advantage the supplies of hydro-electric power in the western Pyrenees, by providing service lines to distant centres of consumption and by regulating the output of the various generating stations, using the surplus, after meeting the requirements of railway traction, for chemical and metallurgical industries. Eleven bodies are now affiliated to the Union, which possesses thirty 'centrales' or generating stations, totalling a maximum available power of 400,000 kva. and producing energy in a normal year to the extent of more than 1500 millions of kilowatt-hours.

Of the thirty stations, the Midi Railway Company operates five of the largest: three in a chain, or

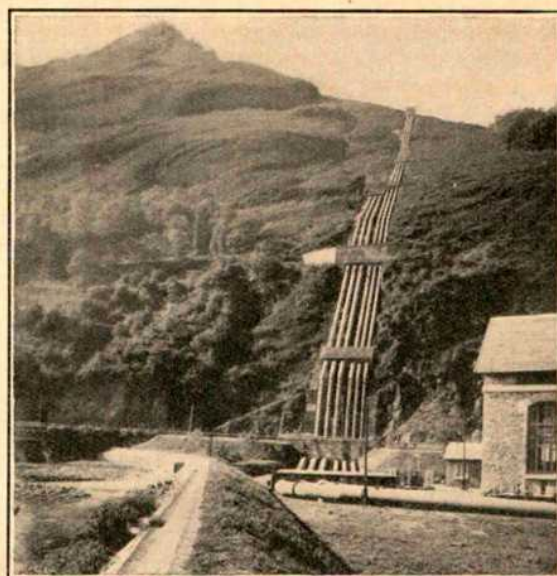


FIG. 3.—Soulom generating station and pipe lines.

bat Station through four pressure tubes of 950 mm. diameter, under a net head of 380 metres. The generating plant consists of five Pelton turbines of 10,000 horse-power each and five alternators of 7000 kilowatts.

The next and final stage is the drop to the level of the station of Le Hourat, which is adjacent to



the head of the railway line at Laruns. The water is conducted through a canal having a length of 5.75 kilometres to four pressure tubes of 1200 mm. diameter, falling through which under a head of 204 metres, it actuates five Francis turbo-alternators of 10,000 horse-power each. Altogether, throughout the entire length of the Ossau Valley, there is plant for the development of 130,000 horse-power, producing 280 millions of kwh. annually.

The detached stations are those of Soulom and Eget. The former (Fig. 3) adjoins the railway line at Pierrefitte and is not far distant from the charming mountain resort of Caunterets, which is reached by an electrically operated tramway. The station at Soulom receives supplies of water from the Gave de Pau and the Gave de Caunterets under very different heads—the former being low and the latter high—necessitating two distinct forms of generation. The net fall of the Gave de Caunterets is 240 metres, and the water is conveyed through three pressure tubes of 810 mm. diameter to two Pelton wheels of 3500 horse-power, each coupled to alternators. The fall of the Gave de Pau is only 106 metres, and in this case the three pressure tubes have a diameter of 1200 mm. and the generating plant consists of three Francis turbines of 3500 horse-power each. The total capacity of the station, accordingly, is 21,000 horse-power, and its annual output is 80 million kwh. It is the smallest of the Midi installations, and was inaugurated before the War. A curious feature which I noticed is the variegated colouring of the pressure tubes, which, at first glance, I thought might possibly be a relic of War-time camouflage, especially as it had a faded appearance. I was told, however, that it was an attempt at æsthetic treatment with the view of harmonising the appearance of the pipes with the mountain background. As such, it could not be considered altogether successful. If a pipe line can be hidden or rendered less obtrusive by shrubs and vegetation, the advantage from a scenic point of view is, no doubt, considerable, but variegated tinting of the pipes only seems to produce a tawdry and unquestionably artificial effect.

The last station to be noticed is that of Eget (Fig. 4), which is located in the high valley of La Neste de Couplan. It benefits in part from an arrangement made in 1870 by the French Minister of Agriculture in order to create dry weather reserves to feed the lakes of the region, the streams of the plateau of Lannemezan, and the district of Gers. The following four lakes have accordingly been impounded so as to provide increased capacities, namely:

|             |                 |
|-------------|-----------------|
| Orédon      | 7,000,000 cu.m. |
| Cap de Long | 7,000,000 "     |
| Aumar       | 1,100,000 "     |
| Aubert      | 4,500,000 "     |

In addition, the Midi Company, by means of a barrage, has formed in the valley of the Oule an artificial reservoir of 6,500,000 cu.m. capacity, receiving supplies from a catchment area of 30 square kilometres. This brings the available reserves for the Eget Station up to 25 million cu.m.

The head at the station is 710 metres, and the water passes through seven tubes of 560 mm. diameter to a corresponding number of turbo-alternators of 5000 horse-power each. The mean annual output is 90 million kwh., of which 30 millions, due to stream flow, must be consumed between the months of April and July, while the remainder, provided by lake supply, can be consumed as required.

Time did not permit me to visit any stations outside the Midi groups. With three exceptions,

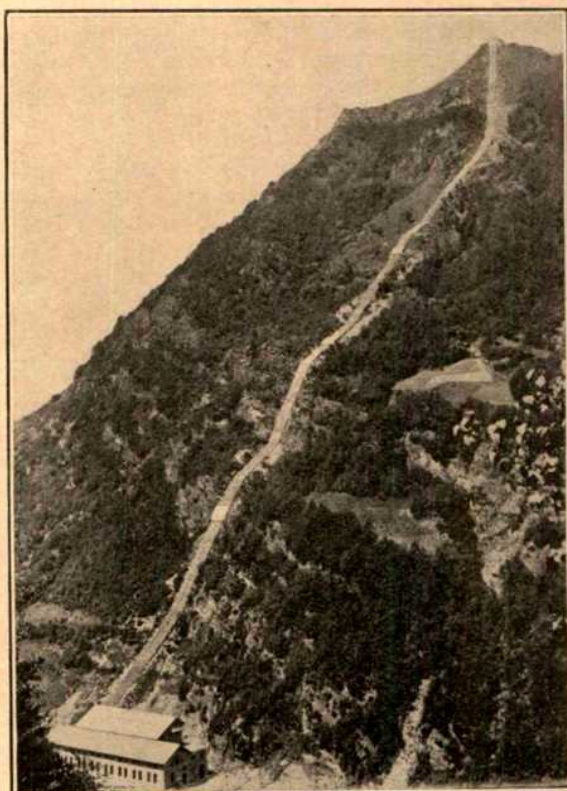


FIG. 4.—Eget generating station and pipe lines.

however, the rest are of relatively minor calibre, that is, less than an aggregate of 20,000 horse-power per station. The largest is one of 50,000 horse-power at Pinet, operated by the *Énergie Électrique du Rouergue*. Two others, of 35,000 and 33,000 horse-power respectively, belong to the *Société Hydroélectrique de la Cère* and the *Sté. des Forces Électriques de la Vallée de Gavarnie*.

An account of the stations can scarcely be considered complete without some reference to the system of distribution, which is very capably organised and constitutes one of the chief duties and responsibilities of the Union. The U.P.E.P.O. takes delivery of the energy furnished by its affiliated concerns at a tension of 60,000 volts at one or other of two transformer stations at Lannemezan or Laruns, belonging to the Midi Company, where, apart from a quota to meet local demands, it is transformed to a voltage of 150,000 and dispatched in the directions of Bordeaux and Toulouse. Each concern undertakes the transport of its own output to the points of delivery. Two lines of



50,000 kw. convey the current to Bordeaux and one of 50,000 kw. to Toulouse and beyond, the total distance exceeding 500 kilometres. At the two extremities of the high-tension system (Bordeaux and Toulouse) and at the intermediate point of Dax there are transformer stations to reduce the voltage again to 60,000. The various demands of traction and industry are met from these centres, as well as from those of Laruns and Lannemezan.

The duties of the central organisation of the U.P.E.P.O. at Tarbes are considerable. Each day it is furnished by its constituent units with detailed particulars of the previous day's output, the energy available, the local requirements, the state of the water supply, lake levels, etc. From these data is prepared a chart of the aggregate resources, and a scheme of apportionment is arranged to meet the fluctuating demand, the

deficiency at one centre being made good by the surplus at another. The whole system is planned, in fact, with the view of eliminating unnecessary waste, obviating local breakdowns or shortage, and ensuring a regular and sufficient supply for the needs of the important region which it serves.

My acknowledgments are due to the U.P.E.P.O., as well as to the Midi Railway Company, for information courteously placed at my disposal and for their kind assistance. The photographs of the stations have been supplied by the Midi Railway Company, from which I learn that, up to the date of writing, a length of 1256 kilometres (say 785 miles) of track is electrically operated, representing about thirty per cent of the whole system. A further 336 kilometres is now being equipped for electric traction, and the electrification of a length of 270 kilometres is under consideration.

### Obituary.

DR. J. P. LOTSY.

THE death of Dr. Johannes Paulus Lotsy, which occurred at Leyden in November at sixty-four years of age, terminates the career of one of the leading workers of the day on evolution and heredity.

Dr. Lotsy's botanical work began when he was sent out to the East Indies in 1896 to study the alkaloids contained in various species of *Cinchona*. The results of his work were published in 1898. He then settled down to a long career of teaching and research in Leyden, varied by frequent visits to almost every part of the globe. In 1906 he published the first part of his "Vorlesungen über Deszendenztheorien", the second part of which appeared two years later. This very useful work was based on his lectures on evolution at Leyden and comprised a comprehensive survey of the state of evolutionary thought at the time. At the same time another monumental work began to appear, "Vorträge über botanische Stammesgeschichte" (3 vols., 1907-1911), an unfinished treatise on the plant kingdom from a phylogenetic point of view.

Lotsy now began to develop the views on evolution and the species question with which his name will always be associated. During the years 1912 to 1916 he published a series of papers putting forward the view that the fundamental unit of taxonomy was the homozygous biotype, and that to this only should be given the name species. Subsequent work has shown that such a unit has no existence in ordinary allogamous populations, and later on Lotsy himself abandoned his opinion and went to the further extreme of doubting the existence of such homozygous biotypes in Nature even in pure lines.

In 1916 Lotsy published his well-known book, "Evolution by means of Hybridisation", in which he vigorously attacked de Vries's work on mutations in *Oenothera*, and claimed that the phenomena observed in that genus were due to the heterozygosity of the material. He advanced the view that the sole method of evolution was by means of hybridisa-

tion, and denied that gene mutations played any part. The book was written in a style entirely the author's own, and many of his views cannot now be maintained, but, nevertheless, it will remain a classic in evolutionary literature. Lately, moreover, evidence has accumulated showing that hybridisation plays a greater part in evolution than Lotsy's critics imagined. One of the most striking examples of this is the grass *Spartina Townsendii*, which has recently been shown, beyond doubt, to have originated from a cross between *S. alterniflora* and *S. stricta*, followed by a doubling of the chromosomes. Other cases could be quoted, and it seems clear that one of the means of evolution of new species is interspecific hybridisation followed by chromosome doubling.

During the last six years, having given up regular teaching on being made emeritus professor at Leyden, Lotsy visited New Zealand, South Africa, and other parts of the world for the purpose of collecting evidence for his views on evolution. He was a tireless worker in the field, and everywhere he went he amassed a wealth of material and brought together a great number of arguments in support of his views. In South Africa he worked especially on the genera *Cotyledon* and *Euphorbia*, and took back material of the former genus to Leyden, where he was breeding them on a large scale. He also turned his attention to hybrid populations in the human species, and a large part of the paper on his South African work, published in conjunction with Dr. Goddijn, deals with the various races he had studied there.

At the time of his death, Lotsy was engaged on a large work dealing with his ideas on evolution, and it is much to be regretted that he did not live to bring it to completion.

Lotsy was always a welcome visitor to Great Britain, his last visit being to attend the London meeting of the British Association. His views, always frank and forcibly expressed, were very stimulating and were generally appreciated; since,

however, he was apt at times to disregard the opinions of some of his botanical colleagues, his theories and conclusions have not perhaps received the recognition which they merit

#### PROF HUGO DE BOCKH

THE recent death at the age of fifty-seven years of Hugo de Bockh will occasion deep grief amongst those who in many lands enjoyed his gifts of friendship, admired his independent judgment and vigorous personality, and feel the loss to science. He was the son of a distinguished Hungarian geologist, and received part of his training under Karl von Zittel at Munich. In 1902, at the age of twenty-eight, he was appointed professor of mineralogy at the Hungarian School of Mines at Selmeczbánya, and there turned his attention to economic geology and to the tectonic problems which he realised would prove of practical value in mining. He wrote a text-book on geology in Hungarian, and amongst other investigations studied the applications of the Eotvos balance to subterranean prospecting. During the War he was appointed Under-Secretary for Mines in Hungary.

In 1923 de Bockh received the appointment which gave him his great opportunity—he became the geological adviser to the Anglo-Persian Oil Company, and had a great influence in its development by his superintendence of its geological work. He was in charge of its surveys in Persia and Mesopotamia, Albania, Colombia, and Venezuela, and of the international survey of the oil-fields of Iraq. In this work his indomitable, restless energy, originality and insight, and his inspiring enthusiasm made him a most efficient leader in the pioneer field work.

Prof de Bockh was asked to succeed Baron Nopcsa in 1929 as director of the Hungarian Geological Institute, and returned to Buda-Pest in 1930. He was given a seat in the upper house of the Hungarian Parliament. It was hoped that as soon as he had reorganised the Hungarian Geological Survey he would have time to publish the general conclusions of his world-wide study of oil-fields and their structures. He had published relatively little, partly owing to lack of time and to much of his work being confidential. His most important contribution was that, in conjunction with Dr G M Lees and Mr F D Richardson, to the British Association symposium on the structure of Asia (1929), in which he included some striking results of a study of the Magdalena rift-valley in Colombia.

Prof de Bockh gave early this year a series of lectures under the auspices of the University of London, in which he summarised his general conclusions on current tectonic problems, and showed his independence of judgment by emphasising the need for caution with Eotvos balance observations and deductions from isostasy. It is to be hoped that those lectures will have been left in a form available for publication, as they state the matured judgments of a geologist of unusual insight and of unique experience and qualifications.

#### MR J H LEONARD

By the death of John Henry Leonard, which took place at a Kensington nursing home on Dec 4, the Trustees of the British Museum have lost the services of one who was the first to hold the office of guide-lecturer at the Natural History Museum. The appointment was, at the beginning, regarded purely as an experiment, and was the result of the steady campaign conducted by the late Lord Sudeley to make the great national museums more attractive and more interesting to the general public.

That the experiment was such an undoubted success at the Natural History Museum was due to Mr Leonard's qualities, which rendered him so eminently fitted to discharge the duties of the post. To hold the attention of a group of people haphazardly brought together for a tour of part of the Museum, and with very varying capacity for understanding and appreciating what they were shown and were told, is no easy task, especially round exhibition cases in galleries of difficult acoustical properties. Mr Leonard possessed the fundamental quality of a good carrying voice, and at the same time was successful in appraising the mentality of the average listener, he was always patient of questioners and took great pains to enlighten the genuine inquirer. With school children he was particularly successful, partly because he was naturally fond of young people, and there are many, of tender years when they first visited the Museum, who will ever bear him in kindly remembrance.

Born on April 19, 1864, Mr Leonard was educated at Kensington Grammar School and at King's College and University College, London. He obtained the B.Sc. degree, his subjects being zoology, botany, and geology, in the last of which he gained honours. He taught science for a time, and was associated with the science sections at some of the exhibitions held at Earl's Court and Shepherd's Bush. He was appointed guide-lecturer at the Natural History Museum on May 20, 1912. Without having written anything, he has done no mean service in awakening an interest in natural history among those who, to the average annual number of 12,500, have attended his tours. He was also a lay reader for whose services in the pulpit there was always a good demand.

WE regret to announce the following deaths

Dr Melvil Dewey, formerly director of the New York State Library, originator of the decimal system of book classification, on Dec 26, aged eighty years.

Mr Beeby Thompson, formerly principal of the Northampton Technical School, who was a well-known consulting water engineer, on Dec 12, aged eighty-two years.

Prof Hermann Thoms, formerly director of the Pharmaceutical Institute of the University of Berlin and president of the German Pharmaceutical Society, aged seventy-two years.

## News and Views.

### Calendar of Geographical Exploration

THE century in which we live, young as it is, has yet been remarkable for its achievements in exploration. Both poles have been reached, much of the previously unconquered Sahara has been explored, surveys have been carried out in the north polar basin, in the antarctic regions, and in north-east Siberia, where a new range of mountains is known, but not yet marked on our maps. Attempts have been made to scale the heights of Everest. Expeditions such as those organised by Sven Hedin, Sir Aurel Stein, and R. Chapman Andrews in Central Asia, and by L. S. B. Leakey in East Africa, have contributed rich stores of geographical, geological, and archaeological knowledge of these regions. In spite of the accumulated experience of centuries and the increasing mastery over the elements which modern science is bringing to mankind, explorers still face situations which call for courage and sacrifice. Men like Oates and Amundsen have continued the tradition of heroism, and their names are added to the long list of pioneers who have willingly sacrificed their lives for others.

INEVITABLY, the character of exploration is changing from the extensive to the intensive. Regional survey in its widest sense, including a study of geology, past and present climates, flora and fauna, and human cultures, is rousing interest in the popular, as in the scientific, mind throughout the world. Scientific regional survey is specially developed in modern Russia and has proved of economic importance in the opening up of the apatite district of the Khibinsk tundra and in the discovery of naphtha-bearing beds in the Urals. The revival of interest in geography in the British Isles is evidenced by its recent inclusion as a separate subject of study in British universities. Our calendar for 1932 will record some outstanding events in the history of exploration. Appropriately enough, the first entries (p. 33) include the names of Scott, Shackleton, and Hassanem Bey, whose work, both from the point of view of science and from that of heroism and endurance, shows our century taking its place in the best traditions of exploration.

### Geological Exploration of the Andes

PROF. J. W. GREGORY is leaving England on Jan. 4 with an expedition to investigate some little-known parts of the coastal cordillera of southern Peru and their relations to the Andes and to the recent extension of South America into the Pacific. It is hoped to examine especially the structure of the part of the Peruvian coast that trends from north-west to south-east, and the geology of the desert belt between that coast and the western front of the Andes. A geological section is also to be prepared across the little-known belt between Ica and the Urubamba valley. The earth-movements and volcanic epochs of the Andes appear to have significant correspondence in date with the main stages in the formation of the Great Rift valley that were discovered in its exploration by Prof. Gregory thirty-

nine years ago. The expedition will descend from the Andean plateau down one of the head streams of the Amazon, and may return to England across Brazil. Miss McKinnon Wood will accompany the expedition especially to collect fossils. Mr. A. V. Coveley Price will join the expedition at Lima. The work will be helped during parts of the journey by Mr. M. A. Tarnawiecki and Señor Don Alberto Calderon.

### Old London Bridge.

THE Exhibition commemorating the centenary of the demolition of old London Bridge, which was opened on Nov. 5 in Regis House, close to the northern end of London Bridge, is to remain open until Jan. 24. The display has been organised by the Rev. H. J. Fynes-Clinton, rector of St. Magnus the Martyr, to raise funds for the restoration of Wren's tower and spire, and many societies and individuals have sent exhibits to it. The series of engravings, water-colours, and prints of the old bridge at various periods of its existence, with and without the houses upon it, and with the new bridge being erected close to it, are of very great interest to students of the history of London, while the two splendid models by Mr. J. B. Thorp are alone worth the trouble of a journey to the spot. The first of these is a 25-ft. model of the old bridge as it was about thirty years before the Great Fire. At the Southwark end are the water-wheels for corn grinding, while at the City end are the water-wheels erected in 1582 by the Dutchman, Peter Morice, for working the pumps which supplied water from the river to certain parts of the City. Mr. Thorp's other large model shows a London street with the Lord Mayor's show passing along it in 1616. Lectures are given on these models at short intervals. While these exhibits are perhaps of general interest, there are others which will appeal to the historian, the antiquary, and the engineer.

### Early Cloth Fulling.

AT a meeting of the Newcomen Society held in Prince Henry's Room, Fleet Street, on Dec. 16, Mr. E. Kilburn Scott read a paper on early cloth fulling and its machinery. Though it has remained for modern science to explain what happens to woollen threads when cloth is treated with moisture, heat, and pressure, the process of fulling, which involves the use of all three, goes back to very early days. There are references to fullers in both the Old and New Testaments, in the city of Pompeii can be seen pictures of the various processes of the fuller's craft and a fullery complete with its basins, cisterns, and compartments, and no one knows when machinery was first introduced which superseded the use of the hands or the feet in fulling. The object of fulling is to fill the interstices of the cloth as woven, to add to its appearance, its strength, and its 'feel', and the coarser the cloth the greater amount of fulling required. Cloth to-day is either treated in fulling stocks, in which are incorporated stamps which are worked somewhat in the same manner as tilt hammers,

or in milling machines with rollers. The fulling stocks have been known for several centuries, but the milling machine was first introduced by John Dyer, of Trowbridge, Wiltshire, who took out patents in 1833 and 1838. Mr Kilburn Scott himself was brought up in the works of Kilburn of Leeds and has been familiar with textile machinery all his life. His paper contained much of interest to the antiquarian, the inventor, and those connected with the cloth industry.

#### Progressive Science and Happiness

• AMONG the publications issued in the United States with the object of directing attention to the value of science and engineering in human progress, are the Research Narratives, published monthly as small folders by the Engineering Foundation, the joint research organisation of the four leading engineering societies of America. Hitherto, these narratives have covered a wide range of subjects, but the last three numbers contain the first contributions by various writers, dealing with benefits from engineering progress. Happiness, it is remarked, has ever been a condition that human beings have earnestly desired, but the question may be asked: How wisely has mankind used the means of happiness provided by engineering? One of the problems yet to be solved is the maintenance, without disastrous fluctuations, of the steady flow of enjoyment through well-ordered production, distribution, and consumption. "The present conditions", says one contributor, "are difficult to contemplate with mental serenity and undisturbed confidence, but they carry more of ultimate value than the prosperous years that preceded them." Many interesting views are expressed, and Dr C. E. K. Mees, director of research of the Eastman Kodak Company, after remarking that happiness is not a thing which depends upon the possession of material things beyond a certain minimum, concludes his article by saying: "I believe that a large portion of mankind will abandon the feverish quest for material things and will employ its greater leisure in the development of art and the cultivation of its soul." The wise use of leisure is certainly one of the problems which is becoming of increasing importance, but perhaps the greatest problem of the moment is the provision for every one of that minimum of material things, the want of which is felt by so many millions.

#### Commercial Crystalline Vitamin D.

THE investigations carried out during the past few years by Bourdillon and his colleagues at the National Institute for Medical Research on the formation of vitamin D have now led to the preparation of a pure crystalline compound, as recently reported by Askew, Bruce, Callow, Philpot, and Webster, in *NATURE* for Oct 31, p. 758. This compound, called by them 'Calciferol', is prepared by the irradiation of ergosterol in ethereal solution under strict anaerobic conditions, excess ergosterol being afterwards removed by fractional crystallisation and with the use of digitonin. The calciferol is separated from other products of irradiation by fractional crystallisation of the dinitro-

benzoates and subsequent hydrolysis of the ester. The process has now been repeated on a larger scale in the technical laboratories of Messrs The British Drug Houses, Ltd., London N 1. The sample of calciferol submitted is a white crystalline solid; it is stated to melt at 114.5° C., to have the same empirical formula as ergosterol, and to have the high vitamin D potency of 40,000 international antirachitic units per milligram. It is available for the use of research workers in tubes containing 100 mgm. The commercial production of pure vitamin D is a satisfactory culmination of the brilliantly directed but laborious research work of the Medical Research Council's investigators, and should lead to greater precision in therapeutics and to the possible discovery of new applications for its use.

#### 69-in Mirror for Perkins Observatory.

DR HARLAN T. STETSON, director of the Perkins Observatory, Ohio Wesleyan University, Delaware, Ohio, informs us that the large 69-inch mirror for the new telescope was installed at the Observatory on Dec 14. The disk of glass, weighing 3000 lb., was cast as an experiment in American glass making in the optical shops of the U.S. Bureau of Standards, in May 1927. The exceptional annealing of the glass, which required eight months of controlled temperature, facilitated greatly the polishing and figuring of the mirror's surface, which was executed in the factory of J. W. Fecker, in Pittsburgh. Exhaustive tests carried on at Pittsburgh by Dr Stetson, Dr J. S. Plaskett, of the Dominion Astrophysical Observatory, and I. C. Gardner, chief of the Division of Optical Instruments, of the U.S. Bureau of Standards, showed the surface to be of the highest order of excellence. Quantitative measurements revealed departures from the mean focus of twenty-five feet to be not greater than 0.01 in. for any zone. The completion of the Perkins telescope brings into the central States the third largest telescope in existence, the two other instruments of greater aperture being the 72-in reflector of Victoria, B.C., and the 100-in reflector at Mt. Wilson, California. These great telescopes in North America have all led the way to important additions to astronomical knowledge, and it may be confidently anticipated that the new instrument, under Dr Stetson's direction, will carry on the tradition.

#### Sixth International Congress of Genetics.

ACTIVE preparations are being made for the sixth International Congress of Genetics, to be held at Ithaca, New York, in August 1932. A series of quarterly bulletins of information has been issued and a number of committees has been at work for more than a year. A recent bulletin outlines the arrangements being made with regard to exhibits in connexion with the Congress. Several laboratory rooms will be used for cytological and other genetical exhibits, including recommended varieties of various crop plants. A new feature proposed is a genetical garden of three and a half acres, in which extensive exhibits of *Zea*, *Nicotiana*, *Oenothera*, *Antirrhinum*, *Petunia*, *Brassica*, and *Melandrium* will be grown from

seeds sent by geneticists in all parts of the world who are investigating these genera. Exhibits illustrating fruit breeding will be shown at the Agricultural Experiment Station, Geneva, New York, and an extensive series concerning human genetics is being arranged in connexion with the Third International Congress of Eugenics, to be held in New York immediately before, on Aug 21-23. A long series of animal exhibits, including domestic mammals and birds, fishes, insects, and molluscs, is also in preparation, the assembling of each group being in charge of a different person. Arrangements have been made for delegates to book passage on s.s. *Westernland* at a special rate of 200 dollars for the return voyage.

SUGGESTIONS have been made that the Congress should be postponed until world conditions improve, but Dr C C Little, of Bar Harbor, Maine, Secretary-General of the Congress, has issued a communication stating that the Council, after prolonged consultation, has decided not to postpone the Congress. Among the factors which influenced the Council in deciding to carry on the arrangements as originally intended, are the facts that a number of prominent European geneticists have already indicated their intention to attend, that a large number of lectureships for visitors to the Congress are being arranged by American universities, that obligations have already been made and commitments undertaken, and that early improvement in economic conditions is uncertain, making postponement inadvisable. Now that the matter is finally settled, it is hoped that all geneticists who can possibly do so will plan to attend.

#### Electric Equipment of the Dolomites Railway

THE narrow gauge Dolomites railway which joins Calalzo, in the Piave valley, to Dobbiaco, a distance of about forty miles, has now been working very satisfactorily for over two years. As the railway passes through Cortina d'Ampezzo, it is much frequented by tourists. The railway is operated by electricity and so there is no smoke and steam to detract from the beauty of the scenery. Fears were entertained in case, during heavy falls of snow, water would get into the motors and interfere with their working. A special arrangement was therefore devised for them so that when necessary they could be made 'enclosed' motors. Even in snow-clearing operations, when they were considerably overloaded, the motors suffered no damage. In the *Brown Boveri Review* for October, A Brodbeck gives an account of the electric equipment of this railway. It receives its power from a three-phase network at Calalzo at a pressure of 18,000 volts, but for operating the railway, direct current at 2700 volts is adopted. This is done by the use of only one substation situated near Cortina, a little more than half-way from the power terminus. The conversion of the alternating to direct current is done at the substation by means of two mercury arc rectifiers each of 11,000 kilowatts capacity at 3000 volts. It is interesting to learn that a momentary load of 200 per cent does them no harm, and that they can withstand a 25 per cent overload for half an hour. Owing to

the comparatively small currents they take, they require little space and their efficiency is extremely high, being 99.1 per cent over a large range of output. The use of rectifiers in railway plants is increasing, and we anticipate a rapid increase in the future.

#### Novel Slot Electricity Meter.

WE learn from *A E G Progress* for October that many hotel, boarding-house, and convalescent-home keepers now instal in their bedrooms a special slot meter to collect the cost of the electric energy consumed by the visitor. It is not uncommon for travellers to carry about with them all kinds of portable electrical appliances which are readily connected to the plugs in the bedroom, notwithstanding the printed regulations to the contrary. This sometimes leads to the blowing of fuses and is a source of fire risk to the building. It is therefore now not uncommon to put slot meters in the bedrooms, so that by the insertion of a coin the guest purchases a given amount of energy. Unlike an ordinary prepayment meter, the coin mechanism can be returned to the 'off' position by resetting a simple device. In this way the new visitor cannot consume at the expense of the previous one any energy that still may be available. The resetting device is actuated by a key, kept by the proprietor, who cancels for his own benefit the credit still due to the departing visitor. The company which makes this meter suggests that the constant source of revenue obtained in this way should be utilised to make the rooms more comfortable, and furnish them with plug points for all kinds of electric devices.

#### Indian Antiquities.

SIR EDWARD GAITT's review of British research work in India in the fields of archæology, philology, and ethnology in his address to the first meeting of the Royal Society of Arts in the current session (*Jour Roy Soc Arts*, Nov 13) records a remarkable achievement, especially when it is taken into account that such research, often demanding intense application, in the majority of cases has been no more than the distraction of a busy official career. India can now boast of an ancient civilisation and a literature, of which the older elements may go back so far as 2000 B.C., but when British rule began in the eighteenth century, Sanskrit literature and lore had lapsed into disrepute, the ancient monuments had been allowed to fall into decay, and the course of events in the Hindu period had been forgotten. From the time when the study of Indian antiquities was placed on an organised basis by Sir William Jones, who had gone to India as a judge of the Supreme Court in 1783, and the Asiatic Society of Bengal was founded, British officials have engaged in all branches of Indian studies with enthusiasm. Forgotten scripts, forgotten languages, and even forgotten empires have been rescued from oblivion, while the investigation of the customs, races, and religions of the people of India has been pursued in a scientific spirit without reference to racial or political prepossessions. Thanks largely to the efforts of



Lord Curzon, ancient monuments have been restored and the care of antiquities made a matter of administrative charge. It is to be regretted that Sir Edward Gait has to record a falling off in the number of British civil servants who now devote themselves to such studies, but on the other hand there is a measure of compensation in the fact that the number of natives of India who are interested in the history and antiquities of their own country is on the increase.

#### Birds of Paradise

In the Bird House and the small Tropical House adjoining it, the Zoological Society of London now exhibits a dozen species of birds of paradise, several of them recent arrivals along with the rare Matschie's tree kangaroo (see NATURE, Dec 12, p. 996), also coming from the Rawlinson Mountains in north-east New Guinea. Most noteworthy is the Emperor of Germany's Bird of Paradise (*Paradisea guineensis*), a species new to the collection, it bears a general resemblance to the well-known Lesser Emerald Bird of Paradise, but has the crown as well as the throat green, and the side-plumes shorter and of a different and less downy texture, more recalling the nuptial plumes of the egrets. Among those species that have been in the collection some time, special mention may be made of the Twelve-wired (*Seleucidus ignotus*), because of the peculiarity it exhibits of having the legs bare for some distance above the hock, as in a wading-bird. This peculiarity is shared by a very different bird from the same zoological region and also in the collection, the great black Palm-cockatoo (*Microglossus aterrimus*), this is noteworthy, for neither affinity nor habits can be invoked for the explanation of this nudity in these two species. A very humble bird by comparison, but also of much scientific interest, is a newly received specimen of the melanistic mutant of the blackcap, this variation, which is found in the Canaries and Azores, has been known for upwards of a century, and is called Heineken's Blackcap. The bird is on view in one of the small cages in the Bird House.

#### British Empire Hardwoods and Turnery

In Museum No. 1 in the Royal Botanic Gardens, Kew, a temporary exhibit of articles turned from Empire hardwoods by the skilled hands of Mr. A. L. Hetherington, assistant secretary in the Department of Scientific and Industrial Research, has been arranged. While indulging his hobby of turnery, Mr. Hetherington also carried on important research, for he worked upon some eighty different kinds of Empire woods, many of which are new to the turner, the results of his work being demonstrated by excellently carved boxes, chalices, tazzas, goblets, dishes, ash trays, and other articles. Particularly beautiful are a chalice made from sapodilla wood (*Achnas Sapota*), two tazzas made of African blackwood (*Dalbergia melanocylon*), a goblet of bulletwood (*Mimusops littoralis*), a string box of puriri (*Vitex littoralis*), and two match stands of gidgee (*Acacia Cambagei*). Mr. Hetherington has added to the value of his demonstrative work by writing an account of the various

kinds of wood used, with particulars of their peculiar working properties. This book has recently been published by the Empire Marketing Board under the title "British Empire Hardwoods from the Point of View of Turnery." After discussing the properties of eighty kinds of wood, he goes into further particulars about those he considers of greatest importance for ornamental turning. All who are interested in wood turnery should make an effort to visit Kew within the next few weeks and inspect this interesting collection.

#### Forest Survey by Aeroplane.

In the development and protection of Canadian forests, aircraft have come to play a most important part. The *Canadian Surveyor* for October in a general account of aviation in Canada explains how aerial photography is used to show the character, distribution, and accessibility of the timber; thus facilitating exploitation on sound lines. Even more valuable is the use of air patrols for noting forest fires, and of air transport in carrying crews and equipment for extinguishing the fires. In Ontario alone during the year 1929 more than three hundred fires were thus detected. Aircraft are also used in combating insect and other pests. These attempts are still in an experimental stage, but the results so far are promising. Areas of fir and spruce affected by spruce budworm and of hemlock and balsam affected by hemlock looper have been dusted with calcium arsenate from the air. The method is certainly cheap and fairly thorough. Experiments in Manitoba have shown the effectiveness of dusting wheat with sulphur in order to fight the destructive wheat stem rust. Aircraft are also being used to expose spore traps, in an endeavour to determine the spread of wheat rust and white pine blister rust.

#### Quantity of Matter in the Universe

In the discussions taking place at the present time on the structure of the universe, the amount of matter distributed throughout the whole of space is determined by calculating the total mass of existing protons and electrons. In all the celestial bodies revealed by the means of observation yet available, the whole number of these corpuscles is found to be  $10^{79}$ . All other hypotheses must, therefore, be based on this figure and on the dimensions of the radius of the universe. In a note by Prof. Gianfranceschi, broadcast from the Vatican on Nov. 26, it was pointed out that limitation of the consideration of this question to that of the matter constituting the corpuscles is scarcely justifiable. Protons and electrons represent a special, but not the original, form of matter. They exert forces of attraction and repulsion originating in their character as electrified corpuscles and in their masses, that is, in measurable magnitudes. The possibility of the transformation and formation of the corpuscles must, however, be assumed. In considering such changes, not merely the energy variations but also the inertia must be taken into account, and any theory of the universe which may be formulated, whether static or dynamic, should be based on these

active and passive principles jointly. The curvature of space is not produced solely either by the visible masses, which must be regarded as singular points of space, or by the energy transported in the form of photons, which in their turn can constitute only lines of singularity, but it must exist in a kind of background or support, filling the universe and composing real physical space. Thus it becomes necessary to be able to express the contribution of this real space, with its twofold element of energy and primordial inertia, to the geometrical scheme of the universe.

#### Flutter of Aeroplane Wings.

In 1928 a monograph on the "Flutter of Aeroplane Wings", by Messrs R. A. Frazer and W. J. Duncan, was produced at the National Physical Laboratory, summarising in a single useful volume the work that had been done by them on that subject up to that time. Since that period this work has been continued, while the associated problem of tail flutter in aeroplanes has also been the subject of study. A new volume has now been produced under the comprehensive title of "The Flutter of Monoplanes, Biplanes, and Tail Units" (Air Ministry Aeronautical Research Committee Reports and Memoranda, No. 1255 (Ae 404) The Flutter of Monoplanes, Biplanes, and Tail Units (a sequel to R and M 1155). By R. A. Frazer and Dr W. J. Duncan. Pp viii + 179 + 12 plates (London: H.M. Stationery Office, 1931, 7s. 6d. net), embodying results that have already been issued from time to time on wing and tail flutter under one cover. The subject is well illustrated by cinematograph pictures of some simple experiments designed to show the various types of flutter that may arise in practice, and the nature of the dynamical problems they expose. While much of the work is of a mathematical complexion, recommendations are included regarding the design of tail units and of biplane wings that should be exceedingly useful to designers. Altogether the monograph is a comprehensive record of a valuable series of investigations. It is understood that the subject of airscrew flutter, which has been under study for some time, will be produced in due course as a separate report.

#### Lead Content of Rocks

PROF. ARTHUR HOLMES points out that there is a serious discrepancy between the data for lead in rocks (a) as given by Prof. Hevesy and Dr. Hobbie and (b) as cited by him in the letters on this subject which appeared in *NATURE* of Dec. 19, 1931. The latter figures (under Pb on p. 1040) refer to the preliminary results obtained by the gravimetric method, whereas those announced on p. 1039 are the final results obtained by the use of the radioactive indicator method. Both sets of figures will appear in a forthcoming detailed record of the investigation. It appears that Prof. Hevesy substituted the final results for the preliminary figures after Prof. Holmes had passed the proofs of his own letter. The effect of the corrections, however, is to emphasise the validity of the conclusions based on the original figures. It now appears that in the composite sample of granitic rocks the

total lead is eight (not five) times the radioactively generated lead. Thus, if the atomic weight of the lead originally present in the earth be taken as 207.22, that of the lead now present in granitic rocks should be about 207.19. Actual determinations on ore-lead correspond very closely with these figures.

#### Prof. Alexis Saposhnikoff

News has been received that Prof. Alexis Saposhnikoff, the well-known Russian chemist, who, as recorded in *NATURE* of April 25, 1931, was arrested about a year ago and condemned to ten years' deportation, has had his sentence so far ameliorated that he is transferred daily to the 'Technical Bureau' under guard, where he works without pay, returning to prison in Leningrad at night. An escaped prisoner reports that he was confined with the "old Prof. Saposhnikoff. Frequently he gave us lectures on poison gas. He spoke well but I did not understand much. Prof. Saposhnikoff had been in prison for a year. The Interrogatories of the OGPU took place between eleven and three o'clock. Prof. Saposhnikoff was often disturbed and returned always very anxious. He and others had their food in the common canteen. Nothing was brought to them from outside, and visits were prohibited. It was like being in a tomb."

#### Announcements.

THE Astronomical Society of the Pacific has awarded its Catherine Wolfe Bruce Gold Medal for the year 1932, "for distinguished services to Astronomy", to Dr. J. S. Plaskett, director of the Dominion Astrophysical Observatory, Victoria, B.C.

It is announced by the Johannesburg correspondent of the *Times* that fire broke out in the main building of the University of the Witwatersrand on Dec. 24, destroying the Gubbins Library and Mrs. Hoernlé's ethnological collections, the Leonard Memorial Law Library, and a natural history collection. The damage to the building is estimated at £20,000.

It is announced by Science Service that Mr. Frederick Hodge has been appointed director of the South-west Museum, Los Angeles, California. Mr. Hodge is well known for his work on ethnology, having conducted several expeditions in order to study American Indian tribes. He was formerly editor of the *American Anthropologist* and of the "Handbook of American Indians", and in 1916 he was president of the American Anthropological Association.

At the meeting of the London Mathematical Society on Jan. 14, there will be a discussion on "Generalisations of Fourier's Integral". The discussion will be opened by Dr. Norbert Wiener, of Massachusetts, and Prof. G. H. Hardy, Prof. E. C. Titchmarsh, and Prof. G. N. Watson, among others, will take part in it. At the meeting on Feb. 4, Mr. M. H. A. Newman will deliver a lecture on "Topological Methods in the Theory of Continuous Groups". Members of other scientific societies who may be interested are invited to attend these meetings, which take place at 5 o'clock at Burlington House.

### Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

### Examination of Protein Films.

THE simplest types of molecular architecture are to be found in materials in the form of films. The examination of films of protein materials is attended with many difficulties, absent in the case of simpler organic substances like the fatty acids.

Whilst the long chain organic compounds containing polar groups can readily be converted into the state of uniform unimolecular films on liquid surfaces on account of their solubility in volatile non-polar solvents, this method is not available for proteins. The method of dispersing the protein in alkaline or acid solutions and spreading the dispersion on a water surface was adopted by Gorter and Grendel, who with the aid of a Langmuir trough obtained a series of interesting measurements on the force-area curves of various proteins. Optical ultra-microscopic examination of such films by Zocher and Stiebel revealed that, except in a few cases, for example, haemoglobin and casein on strongly acid solutions, protein films spread in this manner were not uniform, whilst the magnitude of the mean limiting thickness obtained, 9-10 Å, indicates either that films obtained in this manner even when uniform must be in a relatively close packed state or that part of the protein must have disappeared into the bulk phase. Denatured protein films alone appear to be formed from disperse solutions by the operation of the forces of surface tension, a somewhat lengthy procedure.

We have found it possible to spread a number of proteins such as egg albumen, gliadin, and glutenin in the form of highly disperse uniform films on the surface of water in the following manner: a thin quartz fibre which may for convenience serve as the arm of a microbalance is coated with pure paraffin wax of relatively low melting point. The surface of the wax is lightly dusted with the powdered protein. The protein is then rendered slightly moist by holding the fibre over steam until the increase in weight is some ten per cent of the weight of protein present. On touching a water surface with the fibre tip the protein spreads relatively slowly and apparently quite uniformly over the surface. The microbalance is readily calibrated by spreading myristic acid from the fibre, for both the force-area curves as well as the potential-area curves are well established for this material.

Some proteins, for example, keratin and the xerogel of gelatine, cannot be spread in this manner, and, indeed, unimolecular films of this latter protein do not appear attainable on water surfaces owing to the readiness with which the gelatine undergoes dispersion in the bulk phase. We have examined a number of such films with the aid of a Langmuir trough and, as was to be anticipated, their properties are distinct from the thicker films examined by Gorter and Grendel. In the case of gliadin, for example, a homogeneous film exerting a perceptible surface pressure is obtained with a surface concentration of  $0.36 \times 10^{-7}$  gm/cm<sup>2</sup>. On compression a linear force-area curve is obtained up to a surface concentration of about  $0.7 \times 10^{-7}$  gm/cm<sup>2</sup>. The form of the curve is altered by alteration of the acidity of the substrate. At higher compressions the film, originally fluid, under-

goes transition to a gel-like film. Over a limited range of pressure at least, this transformation appears to be reversible. The 'gel' form is curiously elastic, and the protein in this form may be related to that which, in the bulk phase, is generally described as denatured.

Examination of aqueous protein systems by the method of surface potentials gives us information even more complete than that obtainable from data on the force-area characteristics. It is found, for example, that no change takes place in the magnitude of the vertical component of the electric moments of the polar groups comprising the film material until the two-dimensional sol-gel transition sets in, an indication that this latter form is associated with some type of interaction of the polar groups in adjacent polypeptide chains. A study of the three-dimensional gels of gelatine by this method reveals the fact that the surface phase has a different setting point from that of the bulk phase and is essentially lyophobic in character, but the spreading of fatty acids over sols can readily be followed. The change in the air-liquid potential occurring on the tryptic digestion of an albumen film on a water surface by means of trypsin in the substrate is relatively large, about 75 mv, and permits of closer analysis of such chemical reactions occurring at interfaces.

The dependence of the rate of tryptic digestion in a bulk phase on the acidity of the environment is likewise to be observed in the surface reaction, but with phosphate buffer solutions there appears to be a shift towards the acid side of about 1 pH in the optimum acidity. The characteristic curve of the reaction of trypsin and egg albumen shows that the digestion of the albumen apparently takes place in stages and that an inhibition of the reaction can occur by means of an addition of small quantities of already digested albumen solutions. The digestion of egg albumen by pepsin reveals a simpler mechanism and no final solution of the egg albumen film takes place.

Preliminary investigation holds out some promise of obtaining more precise information both as to the constitution and reactions—general and specific—of protein films by these methods.

ARTHUR HUGHES  
J. SCHULMAN  
ERIC K. RIDEAL

### Absolute Values of X-Ray Wave-lengths and the Fundamental Atomic Constants.

THE wave-lengths of the X-ray spectra are now known with a considerable degree of accuracy (in favourable cases to at least 1 in 100,000). But this means only that the ratio between the wave-lengths and a certain distance within a crystal lattice (for example, the distance between the atomic layers parallel to the cleavage faces of calcite) is measurable with this accuracy. The computation of the dimensions of the crystal lattice from the data involved (electronic charge, density of the crystal, and so on) give the absolute value of the atomic distance with only moderate accuracy (say 3 in 1000). It has therefore been necessary to fix an arbitrary value for the atomic distance in question and thereby for the scale of the X-ray wave-lengths, the *X units*. The agreement between this scale and the C.G.S. units is for this reason ascertained only within the last-mentioned limit. On the other hand, if we were able to fix the scale of the *X units* in centimetres, this gives us a possibility of determining in absolute values the atomic distances and, indirectly, the other fundamental constants (for example, the electronic charge).

A very direct method of determining the X unit in absolute value (centimetres) is to register on the same plate, and with the same spectroscopic outfit, some X-ray spectral lines which have been measured with crystal gratings, and some lines of ordinary spectra the wave-lengths of which are known in angstrom units ( $10^{-8}$  cm)

For this purpose only spectral lines of very short wave-lengths of the same order of magnitude as the X-ray lines (less than 100 Å) can be used. From researches carried out in this laboratory on the spark spectra in the extreme ultra-violet of highly ionised atoms, a number of such lines are now available and may be used for the purpose. Independently of these lines, which have been measured in higher orders by comparison with well-known lines, there is also a second method available, namely, to use lines of short wave-length the value of which can be calculated theoretically for simply built atoms.

The hydrogen-like atoms of the lowest elements may be used with confidence for this purpose. Through the researches in this laboratory, the Lyman series, formerly known for H and He, has been found for the next elements<sup>1</sup> Li III, Be IV, and B V. The wave-lengths of the first member ( $1^2S-2^2P$ ) are respectively Li III 135 01, Be IV 75 94, B V 48 585 Å.

The accompanying spectrogram (Fig. 1) shows,

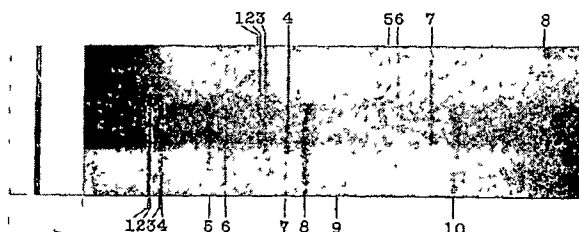


FIG. 1.—Above, spark spectrum of carbon, below, X-ray spectrum of copper and carbon

#### KEY TO LINES

| Upper Spectrum<br>Wave-lengths in Angstrom Units |      |                    | Lower Spectrum<br>Wave-lengths in<br>X Units $\times 10^3$ |                  |                   |
|--------------------------------------------------|------|--------------------|------------------------------------------------------------|------------------|-------------------|
| 1                                                | C V  | $1^2S-4^1P$        | 1                                                          | Cu $L\beta$      | 13 00             |
| 2                                                | C VI | $1^2S-2^2P$        | 2                                                          | Cu $L\alpha$     | 13 31             |
| 3                                                | C V  | $1^2S-3^1P$        | 3                                                          | Cu $L\eta$       | 14 87             |
| 4                                                | C V  | $1^2S-2^1P$        | 4                                                          | Cu $L\zeta$      | 15 26             |
| 5                                                |      |                    | 5                                                          | O $K\alpha$      | 23 56             |
| 6                                                |      | $2 \times 33\ 717$ | 6                                                          | Cu $L\alpha$ II  | $2 \times 13\ 31$ |
| 7                                                |      | $2 \times 34\ 97$  | 7                                                          | Cu $L\alpha$ III | $3 \times 13\ 31$ |
| 8                                                |      | $3 \times 40\ 28$  | 8                                                          | C $K\alpha$      | 44 50             |
|                                                  |      |                    | 9                                                          | Cu $L\alpha$ IV  | $4 \times 13\ 31$ |
|                                                  |      |                    | 10                                                         | C $K\alpha$ II   | $2 \times 44\ 50$ |

below, a number of X-ray lines the wave-lengths of which are known on the X unit scale. Above is registered a spark-spectrum of carbon with wave-lengths covering the same region. These lines belong to carbon atoms with one and two electrons (C VI and C V). Their values are now known in angstrom units. The first line of the Lyman series of carbon (C VI), which is seen as a strong line on the spectrogram, may be calculated from the hydrogen atom model with more than sufficient accuracy (as  $33\ 740 \times 10^{-8}$  cm). With the aid of all these lines in different orders it will be possible to establish the relation between the X unit and the angstrom unit (or the centimetre).

The spectrogram shown was taken with the spectrometer described by Siegbahn and Magnusson,<sup>2</sup> using a small plane-grating with 600 lines, the ruled surface

being 1 mm in width. Before giving definite values we wish to make exposures under varied conditions and using different gratings.

MANNE SIEGBAHN  
MARTIN SODERMAN

Uppsala Physical Laboratory,  
Nov 17

<sup>1</sup> Edlén, NATURE, 125, 233, Feb 15, 1930, 127, 405, March 14, 1931

<sup>2</sup> Siegbahn u. Magnusson, Zeit für Phys., 62, 435, 1930

#### Experimental Proof of the Spin of the Photon.

In a paper under this title which has recently appeared,<sup>1</sup> we have described and discussed observations which have led us to the conclusion that the light quantum possesses an intrinsic spin equal to one Bohr unit of angular momentum. In the four weeks which have elapsed since that paper was put into print, the experimental technique has been much improved in the direction of attaining greater precision. It appears desirable forthwith to report our newer results, which confirm the conclusion stated above.

As mentioned in earlier communications,<sup>2</sup> the experiment we set before ourselves was to determine the extent to which the depolarisation of Rayleigh scattering of monochromatic light is diminished when it is spectroscopically separated from the scattering of altered frequency arising from the molecular rotation in a fluid. An important improvement on our previous arrangements is the use of a pointlike mercury arc, which enables an intense beam of monochromatic light to be obtained which is rigorously transverse to the direction of observation. In the case of the feeble scattering by gases, a serious source of error is the parasitic illumination from the walls of the containing vessel. We have succeeded in eliminating this by using the gas under pressure in a steel cross with suitable arrangements for securing a dark background. The depolarisation of the scattered light is determined photographically with a spectrograph and a large nicol placed in front of the slit. The use of Schwarzschild's formula for photographic blackening enables the ratio of the horizontal and vertical components of scattered light to be calculated from the times of exposure in the two positions of the nicol which give equal densities in the spectra.

Using alternately a fine slit and a very broad slit on the spectrograph, the depolarisations of the Rayleigh scattering and of the total scattering respectively are determined. The following table gives the values for the case of oxygen, carbon dioxide, and nitrous oxide gases under pressure.

TABLE. DEPOLARISATION PER CENT

| Gas              | Observed         |                     | Calculated                |             |
|------------------|------------------|---------------------|---------------------------|-------------|
|                  | Total Scattering | Rayleigh Scattering | Kramers-Heisenberg Theory | Spin Theory |
| O <sub>2</sub>   | 6.5              | 4.1                 | 1.7                       | 4.2         |
| CO <sub>2</sub>  | 10.3             | 6.3                 | 2.8                       | 6.7         |
| N <sub>2</sub> O | 12.0             | 7.7                 | 3.4                       | 7.9         |

The depolarisations of the total scattering given in column 1 thus found spectroscopically are in good agreement with the best accepted values determined by other methods. Column 2 gives the observed depolarisations of the Rayleigh scattering, column 3 the values calculated from the Kramers-Heisenberg dispersion theory, and column 4 the values calculated from the theory of the spinning

photons discussed in our paper. It will be seen that the values given by the latter are strikingly supported by the experimental results.

C V RAMAN  
S BHAGAVANTAM

210 Bowbazar Street,  
Calcutta, India,  
Nov 29

<sup>1</sup> *Ind Jour Phy*, vol 6, p 353, Oct 1931  
<sup>2</sup> *NATURE*, 128, pp 576 and 727, 1931

### Wave-length of the Green Auroral Line Determined by the Interferometer

SOME years ago Babcock<sup>1</sup> gave results of accurate measurements with an interferometer method of the green line which appears in the light from the night sky. We have reason to believe that this line is identical with the strong green line appearing in the auroral spectrum, but on account of the great interest attached to this line it will be of importance to measure accurately the wave-length of the green line from the aurora itself in order to settle the question as to the identity of the two lines.

As I mentioned in a report at the Congress of the Geophysical Union at Stockholm, I was preparing for such investigations to be carried out at the Northlight Observatory at Tromsø, recently built by grants from the International Education Board founded by Rockefeller.

The apparatus used consists of a Fabry-Perot etalon placed in front of the lens of a camera. Two silver-coated quartz etalons—about 2.5 and 5 mm thick—

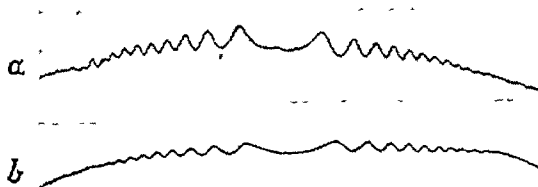


FIG 1

were made by Messrs Adam Hilger, Ltd, London. Their optical thickness was measured by the National Physical Laboratory. The camera lens was an Eremen anastigmat of focal distance 10.5 cm and of high light power  $F$ , 1.18. The part of the light having a wave-length shorter than about 5200 Å was removed by a Wratten filter placed in front of the etalon. The whole apparatus was put into an isolated box, where the temperature could be measured and kept fairly constant.

Recently two exposures of interference fringes of the auroral line were made with the 2.5 mm etalon at the Tromsø Observatory, one on Sept 14 and the second on Oct 29. Both exposures showed a large number of fringes (on the original plate 18-20 could be counted), and no sign of doubling or dissymmetry of the line was to be seen. The neon line 5852.488 Å was used for comparison.

During the first exposures the regulation and measurements of the temperature were not satisfactory. During the exposures of Oct 29, however, the temperature in the box on both sides of the etalon was measured at regular intervals.

Diagrams of the interference fringes corresponding to the exposures of Oct 29 and obtained with a Moll microphotometer are shown in Fig 1. The curves (a) and (b) correspond to the auroral line and the neon line respectively.

Details regarding standardisation of the plates and

methods of calculation will be given in a subsequent paper. I will state here merely the results from the observations of Oct 29, which may be considered as satisfactory.

The wave-length was calculated in the following two ways:

(1) The vacuum wave-length is found from the equation

$$\lambda_N = \frac{2e\mu}{P_N} \quad (1)$$

where  $\mu$  is the refractive index and  $e$  the thickness of the etalon reduced to the temperature of observation,  $P_N$  is the order number for the centre of the auroral line ring-system. The true temperature was found by means of the neon line fringes.

(2) The comparison line was used directly and the wave-length found by means of the equation

$$\lambda_N = \frac{P_c \mu_c}{P_N \mu_c} \lambda_c (1 + \epsilon) \quad (2)$$

where  $P_c$ ,  $\mu_c$ ,  $\lambda_c$  are order number, refractive index, and wave-length corresponding to the comparison line,  $\epsilon$  is a small correction due to difference of temperature of the etalon at the exposure of the auroral line and that of the neon line. This temperature difference was measured directly.

Calculation according to (1) gave for the wave-length of the auroral line

$$\lambda = 5577.340 \text{ Å (I U)}$$

The second method gave

$$\lambda = 5577.345 \text{ Å (I U)}$$

The main error in our experiments is due to uncertainty in the temperature measurements, but should not exceed 0.01 Å. We are improving our arrangements so as to obtain a higher constancy of temperature.

As an average of his measurements, Babcock found  $\lambda = 5577.350$ . Thus, within the limit of error, the green line of the aurora is identical with that of the night sky luminescence.

L. VEGARD

Oslo, Nov 17

<sup>1</sup> *Astrophys Jour*, 57, 1923

### Some Effects of Turbulent Pressure

IN a recent paper Ertel<sup>1</sup> has shown, at some length, that turbulent motion in the atmosphere reduces the pressure, recorded by a barometer, by  $\rho w'^2$  dynes/cm<sup>2</sup>, where  $\rho$  is the density of the air and  $w'$  is the vertical component of the turbulent velocity. This result we can get quite simply from analogy with the kinetic theory of gases, as pointed out by McCrea<sup>2</sup>. Ertel estimates that a mean wind-speed near the ground of 10 m/sec would lower the local pressure by 0.08 mb, a calculation from the observations of Scrase<sup>3</sup> gives results of the same order.

It seems unnecessary that there should be equipartition of eddy energy in the three directions,  $Ox$  down-wind,  $Oy$  across, and  $Oz$  vertical, this, in fact, is shown from the observations of Scrase on pages 6 and 12 of the paper quoted. Considering in a general way the manner of formation of the eddies by friction at the earth's surface, one would suppose that the  $u'$  and  $w'$  components of the eddy motion would be of larger order than the  $v'$  (cross-wind) component, especially in observations taken over a short period, like one minute, but Scrase shows that the  $v'$  component is 30-50 per cent greater than the  $w'$ , particularly near the ground (1.5 metres).

Now consider two points  $P$  and  $Q$  at the same level and at, for example, 100 metres from one another across wind, then the surface 'roughness' at  $P$  and

$Q$  may well be different or the immediate past history of the air or  $P$  and  $Q$  may differ in height from the ground by perhaps 5-10 metres in undulating country. Any of these effects will cause a difference between the values of  $w^2$  at  $P$  and  $Q$ . But a difference of 0.001 mb in pressure over a distance of 100 metres in latitude  $55^\circ$  requires an air-flow of about 8 m/sec for stability. So the only way to avoid, maybe violent, readjustments is for the horizontal components of the turbulent energy to differ between  $P$  and  $Q$  by the same amount as the vertical components. This gives us at once that, for a steady state, the horizontal contributions to the eddy-energy at any point must differ from the vertical by an amount which is constant over a wide horizontal area.

When the mean wind velocity or vertical temperature gradients are varying every few minutes it will take time for the turbulent energy over some distance to readjust itself, this may account for the components of turbulent velocity measured by the standard autographic instruments being about three times as great, for the same mean wind-velocity, as those obtained from a light sensitive vane (Serase, loc. cit.) On a larger scale this readjustment is very likely a cause of the 'wind-swinging' described in a letter by Johnson<sup>4</sup> some years ago, he says that it is accompanied by microbarograph oscillations of the order of 0.05 mb, with a period of 6-8 minutes.

This also has some bearing on the turbulent motion of liquid between two coaxial vertical rotating cylinders. Taylor<sup>5</sup> has studied this problem. The work of earlier experimenters showed him that the turbulence could not be two-dimensional, he calculated the disturbance, if restricted to symmetry about the axis of rotation, and verified his calculations by experiment. But why should there never be two-dimensional turbulence? Ertel's result may show us. With the usual cylindrical co-ordinates,  $r, \theta, z$ , two-dimensional disturbances would be in  $r$  and  $\theta$  only, this would reduce the mean static pressure at the level,  $z_0$ , considered, but as the average depth of the liquid is not changed, vertical, or  $z$ -, disturbances must occur at the same time as the  $r$ - and  $\theta$ -disturbances in order to support the liquid above  $z_0$ . Two-dimensional turbulence is thus not possible in the motion of liquid between a pair of vertical coaxial rotating cylinders.

O F T ROBERTS.

University of Aberdeen,

Nov 27

- <sup>1</sup> *Met. Zeit.*, 47, p 22, 1930
- <sup>2</sup> *M N R A S.*, 89, p 721, 1929
- <sup>3</sup> *M O Geophysical Memoirs*, No 52
- <sup>4</sup> *NATURE*, 115, 263, 1925
- <sup>5</sup> *Phil. Trans. Roy Soc. A*, 223, p 289, 1922

#### *Deinotherium* in the Pleistocene.

THE discovery made by the East African Archaeological Expedition on Nov 17 last, announced in the *Times* of Dec 3 (see also *NATURE*, Dec 12, p 995, and Dec. 26, p 1075), of *Deinotherium* remains in implementiferous Pleistocene deposits is extremely important. It is, however, not quite the first of its kind, for M Delpierre, a Belgian geologist who had been working on the sediments of the Albertine rift near Ngeti, told me, a year or two ago, that he had discovered *Deinotherium* teeth and bones in beds which, on other evidence, he was convinced are of Pleistocene date. He affirmed, too, that these most unexpected fossils were not derived

Now, at Kurungu in South Kavirondo, Kenya Colony, on Lake Victoria, there is a series of fossiliferous sediments, made known to geologists by the researches of Dr Felix Oswald, which largely, though not entirely, because they yield *Deinotherium*, are

regarded as Miocene, in spite of the fact that the contained Mollusca are all living species. In January 1930, I discovered large developments of these beds farther north, on Rusinga Island and on the mainland near it. The strata are there interbedded with lavas and volcanic tuffs which might well prove valuable for dating purposes over a limited area. Lying on these sediments I found a crude *coup de poing* which, judging from the appearance of its surface, seemed to have been derived from the underlying beds; but as these were to be dated as Miocene, I considered any such derivation impossible, and so regarded the artefact as a purely surface find and of little consequence. The Oldoway discovery, however, would seem to render the alternative explanation possible.

A study of the map is sufficient to show, apart from indisputable geological evidence, that Lake Victoria, with its drowned coastline and reversed feeders, is younger than the main river channels, the upper courses of which are submerged beneath it. Yet on the Kavirondo evidence, part of it at least dates back to the Miocene. Clearly, then, a difficulty would be solved if the deposits at Kurungu and Rusinga could be regarded as, say, Plio-Pleistocene, or lower to middle Pleistocene, and laid down, in part at any rate, during the first pluvial period—I long ago pointed out that if anybody wanted a pluvial period in the Miocene, the Kurungu could provide the necessary evidence—and from what has been said above, this interpretation is seen to be no longer out of the question. But there is more. Controversy has arisen between Prof J W Gregory and the East African Archaeological Expedition (1926-27 and 1928-29) concerning the age of the Kamasian beds in the Eastern Rift valley. Gregory correlates these with the Karungu deposits, and therefore regards them as Miocene, but Leakey, on the sound evidence of the discovery of stone tools therein, regards them as Pleistocene and laid down during the first (Kamasian) pluvial period. It would appear then, in the light of the discovery of *Deinotherium* in Pleistocene beds at Oldoway, and the possibility that my *coup de poing* was derived from beds of Karungu date, that Gregory's correlation is not unsound, as Leakey thought, and that the artefacts were in the Kamasian beds, which Gregory disputed. (In this connexion see *NATURE*, Dec 19, p 1019.) Moreover, if this contention is admitted, another riddle in the history of Lake Victoria is satisfactorily solved.

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Ramsgate, Dec 10

#### Ether-Drift and Gravity

It is well known that, by means of electrodynamic experiments, no one has yet succeeded in ascertaining the cosmic movement of the earth, which, particularly in relation to the spiral nebulae, amounts to very high velocities. Apart from the still incompletely explained results obtained by Miller, which, from the work of Joos, should undoubtedly be considered as perturbations, Courvoisier at Potsdam and Esclançon at Strasbourg recently got positive results. These are interpreted by Courvoisier as indicating a Lorentz-contraction of the earth, in consequence of a movement of the earth towards the light-ether with a speed of 750 km/sec and with an apex at  $A = 60^\circ$ ;  $D = 40^\circ$ . In 1926 one of us (R T) demonstrated—by means of a very much refined repetition of Trouton's and Noble's experiments—that such a Lorentz-contraction is not obtainable electro-dynamically, although 1/2,000,000 of the effect asserted by Courvoisier must have been detected in this way.



As to the existence of the periodic variations of gravity, which Courvoisier observed to be of the order  $dg/g = 3-6 \times 10^{-6}$ , the problem is different. Up to the present we have so little experimental knowledge about gravity that such alterations through cosmic movement of the earth, which undoubtedly exists, cannot be ruled out as impossible.

For these reasons we have tried to study the tidal variations of gravity with all the exactness attainable. We succeeded in increasing the sensitivity and, above all, in reducing the perturbations to such a degree that we are now able to give certain proof of periodic variations of gravity of the order  $dg/g = 10^{-8}$ . We used a bifilar gravimeter which, by suitable choice of dimensions, could be made so sensitive as to record a variation of gravity of  $10^{-7}g$  by a deflexion of about 2-3 mm. In order to prevent the apparatus from being disturbed by changes of atmospheric pressure and humidity, it was sealed up hermetically. In order to avoid vibrations of the ground, it was erected 20 m inside a mountain, in a special room about 25 m below the surface. Registration as well as exact adjustment was done from another room equally isolated. Thus the constancy of temperature during a measuring period of two to three days in each special case amounted to  $1/1000^\circ$ .

Even in the unreduced curves the results obtained did not show any greater variations than about  $2.3 \times 10^{-7}$ , as the order of the tide-effects of the sun and the moon.

Adjusting the curves to sidereal time, during the period of observation up to the present time (7 weeks), it appears that any cosmic influence on gravity cannot exceed the order of about  $10^{-8}g$ . Therefore the variation of gravity asserted by Courvoisier of about  $10^{-6}g$  in consequence of the cosmic movement of the earth does not exist.

On account of their geophysical interest the experiments are to be continued with further improvements.

R. TOMASCHKE  
W. SCHAFFERNICHT

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Marburg/Lahn, Dec 1

#### Artefacts of Upper Palaeolithic Facies from Coombe Deposits underlying the Gravels of the Flood Plain

I HAVE lately recorded in these columns<sup>1</sup> the occurrence, south of the Thames, of a 'floor' yielding flint implements of Upper Palaeolithic types and fragments of coarse pottery inter-stratified between Coombe Deposits. The relation of these Coombe Deposits to the Gravels of the Flood Plain has been clearly demonstrated, north of the Thames, by the officers of the Geological Survey.<sup>2</sup> For there the Flood Plain Gravels may be seen overlying the Coombe Deposits, the latter, as at Greenhithe, consisting, in ascending order, of Coombe Rock, coarse gravel, brickearth, and stony loam containing 'rafts' of Coombe Rock.

I am now able to report that this brickearth or 'sandy loam' yields artefacts presenting the same characteristics as do those from the brickearth at Greenhithe.

It is generally accepted that the Magdalenian horizon occurs resting upon the surface of the Flood Plain Gravels, whilst the Solutrian level immediately underlies them,<sup>3</sup> so that on stratigraphical evidence the Greenhithe series must belong to a period even more remote, that is, Aurignacian-Upper Mousterian times.

Through the good offices of the managing director of the Associated Portland Cement Manufacturers Co.,

Ltd, I am conducting an examination of the deposits in question, and the results obtained will be fully published in due course. J. P. T. BURCHELL

30 Southwick Street,  
Hyde Park, W 2, Nov 27

<sup>1</sup> NATURE, 128, 548, Sept 26, 1931, 128, 909, Nov 28, 1931

<sup>2</sup> Mem. Geol. Survey, 1924, Dartford, pp 107 and 109

<sup>3</sup> Moir, J. Reid, Proc. Prehist. Soc. E. Anglia, 6, 200, 1930

#### Diamagnetism of Liquid Mixtures

AN investigation of binary mixtures of diamagnetic substances (one of the substances being water) made in this laboratory has shown a small but definite departure from additivity. The measurements are made with an improved Curie-Cheneveau magnetic balance.<sup>1</sup> In view of the controversy concerning chloroform-acetone mixtures, it has been of interest to examine this system.

The susceptibility-concentration curve is not straight, but any departure from additivity is small—unlike that found by Trew and Spencer.<sup>2</sup> The curve is of the same type as found by Buchner<sup>3</sup> for alcohol-carbon disulphide. There is a flat maximum at equimolecular proportions of the two substances, which shows the diamagnetic susceptibility at this point to be 3.4 per cent higher than additivity. The two minima on the curve show a departure from additivity of the same order. An interesting point is that at the two ends of the curve there is a slight rise in diamagnetism, showing, possibly, molecular dissociation when a small quantity of one liquid is added to the other. The departure from additivity is of the same order, three per cent, as that recorded by Ranganadham,<sup>4</sup> and slightly greater than the two per cent recorded by Buchner.<sup>5</sup>

Trifonov<sup>6</sup> has described a curve for chloroform-acetone concave towards the abscissae. The values found here for the susceptibility of the pure substances are in agreement with other investigators,  $-0.60 \times 10^{-6}$  for acetone, and  $-0.498 \times 10^{-6}$  for chloroform.

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<sup>1</sup> Phil. Mag., 12, 283, 1931

<sup>2</sup> Proc. Roy. Soc., A, 131, 204, 1931

<sup>3</sup> Zeit. für Physik, 72, 344, 1931

<sup>4</sup> NATURE, 127, 975, June 27, 1931

<sup>5</sup> NATURE, 128, 301, Aug 22, 1931

<sup>6</sup> Ann. Inst. Anal. Physico-Chim., Leningrad, 3, 434, 1926

#### General Expression for Intensity of Hydrogen Lines.

I HAVE obtained a formula for the total intensity of hydrogen lines in the general case of the transition  $n \rightarrow n'$ . The calculation is based on the principles set out in Sommerfeld's "Wave Mechanics" for the determination of intensities.

The corresponding formulæ for the special cases of  $n' = 1$ ,  $n' = 2$  were published some time ago and are as follows:

$$n' = 1 \quad \frac{2^7(n-1)^{2n-1}}{n(n+1)^{2n+1}}$$

$$n' = 2 \quad \frac{2^6(n-2)^{2n-3}}{n(n+2)^{2n+3}}(3n^2-4)(5n^2-4)$$

I have proved that in the general case the total intensity can be expressed in terms of hypergeometric series in the following form:

$$\frac{2^4(n-n')^{2n+2n'-1}}{n^2n'^2(n+n')^{2n+2n'}} \left\{ \left[ F\left(-n+1, -n', 1, -\frac{4nn'}{(n-n')^2}\right) \right]^2 - \left[ F\left(-n'+1, -n, 1, -\frac{4nn'}{(n-n')^2}\right) \right]^2 \right\}$$

L. McLEAN

69 Gloucester Place, London, W 1, Nov 15

## Research Items.

**Jemdet Nasr**—An account by Mr Ernest Mackay of the archaeology of Jemdet Nasr, Iraq, excavated by the joint Field Museum-Oxford Expedition, is published as *Anthropological Memoirs*, vol 1, No 3, of the Field Museum of Natural History, Chicago. The site, which is situated about fifteen miles north-east of Kish, has now been identified as the ancient Kid-Nun-ki. It consists of a chain of mounds running east-north-east by west-south-west, about 850 metres long by 180 metres wide, the largest mound being roughly 360 metres by 180 metres. The pottery and small antiquities point to a close kinship with the lower levels of Susa and Musyan. Thus, the identity or close similarity in the design of seals of unusual or curious type is explicable only as due to a close connexion, resemblances in methods of working vessels of stone, and in the shapes of several types of pottery, point in the same direction. The painted pottery of Jemdet Nasr is probably rather later than that of Musyan and Susa II, but, on the other hand, it is earlier than the time of Cemetery A, at Kish. Notwithstanding the absence of burials, the objects found prove the existence of an advanced chalcolithic civilisation in Babylonia at an early period. The system of writing had barely emerged from the pictographic stage, but weaving, fishing, agriculture, and pottery-making, in which the inhabitants excelled, were practised. The brick-making is superior to any other in pre-Sargonic times, but in size and shape the bricks are peculiar, being flat instead of plano-convex. Many objects from the Indus valley resemble those of Jemdet Nasr. It is concluded that the inhabitants were not Sumerian but a people conquered by the Sumerians. Prof Langdon, however, relying to a certain extent on later evidence, says it is impossible not to regard them as Sumerians. Taking 3500 B.C. as the date of the destruction of Jemdet Nasr by fire, he thinks occupation of the site may go so far back as 4000 B.C.

**Pneumonia on the Rand**—Pneumonia used to be a formidable disease among the native workers in the Rand mines of South Africa. Following the use of preventive inoculation with pneumococcal vaccine, a marked diminution in the pneumonia incidence resulted. However, we learn from the annual report for 1930 of the South African Institute for Medical Research, that since 1926 this vaccine has apparently been exerting a somewhat lessened influence in preventing the disease, the mortality rate per 1000 population rising from 2.52 in 1926 to 3.60 in 1930. A study of the disease shows that the original strain of infecting pneumococcus, the causative micro-organism, has been largely replaced by other strains against which the original vaccine is less effective, and these new strains are therefore being incorporated in the preventive vaccine. Further, in a large proportion of the cases the pneumococcus is no longer the principal infecting agent, various other micro-organisms taking its place.

**Antlers of Deer**—In a new analysis of the weights of the antlers and the bodies of various species of deer, Prof Julian Huxley carries further the comparison which he began in a former paper (*Proc Zool Soc*, p 820, 1931). In the mass, the 527 adult examples of red deer show that antler-weight bears to body-weight a constant relationship, which includes a steady relative increase in the weight of the antlers. Although a close analysis of individuals, grouped according to the regions of their origin, does not support this result, probably because the examples are extreme, it is confirmed by an examination of regional groups

as a whole. On the other hand, roe deer definitely show a reverse correlation, for in them, judging from 405 wild adult individuals, relative antler-weight decreases with increasing body-weight. When we turn to New Zealand red deer, originally imported from Great Britain, we find exceptionally high relative antler-weights associated with exceptionally heavy body-weights, the former due to the latter, and the latter due to a particularly favourable environment. It seems probable, therefore, that diagnoses of species or sub-species of deer based upon absolute size or relative size of parts cannot be regarded as valid, until it has been shown that the characters selected as diagnostic are genetic and not direct environmental modifications.

**Morphology of the Insect Abdomen**—Under the above title, Dr R. E. Snodgrass of the United States Bureau of Entomology has published an important paper in the *Smithsonian Miscellaneous Collections* for 1931 (vol 85, No 6). It is generally accepted that the insect abdomen consists primarily of twelve segments, the first eleven of which are true somites and the last is the telson. The eighth and ninth segments are the genital segments and bear the gonopods. The genital opening in the female is located, typically, behind the eighth sternum and that of the male behind the ninth. The abdominal appendages of adult and larval insects are serially homologous with the legs and mouth-parts. Each consists of a basis and one or two movable appendicular processes. The basis appears to comprise the coxal and subcoxal regions of a typical appendage. The basis of an abdominal limb usually is incorporated as a plate of the body-wall or united with the sterna. The appendicular processes are very commonly (in the lower insects) the styli or their derivatives, including the claspings organs borne by the male gonopods of the higher insects. The other processes are the gonapophyses. No positive evidence can be adduced from the known facts of anatomy or embryology to establish the homology of either the stylus or gonapophysis. The author inclines to the view that the stylus is the telopodite of the appendage and that the gonapophysis is an endite process of the basis. The main objection to the view that the styli of *Machilis* are the homologues of telopodites is the fact that very similar organs are borne by the thoracic legs. The similarity in the two cases may be misleading, and there seems to be nothing to show that the leg styli are not merely coxal spines resembling in form the abdominal organs bearing the same name.

**Effect of Ultra-Violet Light on Plants**—The production of a glass which allows the passage of ultra-violet light, and the discovery of the antirachitic properties of foods exposed to such radiations, has quickened interest in the effects of these rays on plant life. Experiments have been carried out by W. E. Tottingham and J. G. Moore (*Journal of Agricultural Research*, 43, p 133) to compare the development, and to some extent the composition, of twelve species of economic plants grown under ordinary and vita glass, and to determine whether the use of the latter is of any commercial advantage. The heating effects with vita glass, due to its relatively high transparency to infra-red rays, were largely compensated for by ventilation, but it is realised that some of the results obtained may be attributable to increased temperatures. Marquis wheat developed a darker colour and more erect habit under vita glass, and seed production also benefited. Such differences were not found with

all varieties of wheat, however, nor under all seasonal conditions. Maize and tomato attained a larger size, and in the case of tomato produced more succulent fruit under vita glass, but with both species these larger plants were less hardy towards frost. Soy beans showed an increase in reproductive activity, together with earlier maturation, than plants grown under ordinary glass. As regards the rooting of cuttings, the results were somewhat inconclusive, but the balance was slightly in favour of vita glass in the case of chrysanthemums. The lipid content of the dry matter was in many instances higher in the vita glass plants, but alterations in the protein also occurred in some cases. Although practical application of the results from the commercial point of view seems as yet distinctly limited, there are indications that further investigations along these lines may lead to enhancement of the medicinal potency of plants.

**Cultivation of Mushrooms**—The application of scientific methods to the practice of horticulture proceeds slowly but surely. It is nearly thirty years since the idea of using a pure culture of mushroom spores propagated on sterile manure was introduced. The gardener is now beginning to use it. The introduction of Bulletin No. 34, "Mushroom Growing", by the Ministry of Agriculture and Fisheries, is therefore very opportune, especially as it describes the new processes in simple language and compares them with the old. The preparation of mushroom beds, spawning, 'casing', and other treatment are all dealt with fully, and there is a section on harvesting and marketing. Perhaps the most valuable section of the book is that on diseases and pests. The grower and the student have long waited for some authoritative collection of the information about these subjects, and in the book under review the latest work on the Mycogone disease is summarised. A list of the important works on cultivation and diseases is appended, and will be of great value to the advanced grower and the student.

**Termites in the Formation of Spongy Ironstone in Africa**—Peculiar outcrops of brown ironstone (limonite) of a spongy texture form a feature of the higher regions of Central Africa, particularly of Angola. Livingstone was the first author to direct attention to them so far back as 1857, and white residents in these parts of Africa found them an excellent building material. Dr Malcolm Burr and Mr P. S. Nazaroff, who have recently travelled in Angola, came to the conclusion (*Geol. Mag.*, vol. 68, 1931) that the ironstones present nothing else than subfossil remains of termitaria. The process of ferruginisation of termitaria can be observed even now, being independent from the activities of insects themselves, and is clearly a process of deposition of iron from rain water soaked through soil. When nests are near rocks rich in silica, such as quartzose sandstones, an analogous process of silicification occurs, and the old termitaria are converted into a completely silicified but spongy rock.

**Luminous Phenomena accompanying Earthquakes**—The luminous phenomena of earthquakes have been described as forming the darkest chapter of seismology. Though many writers have been sceptical as to their reality, their existence has been established by Mr K. Musya, who collected about fifteen hundred observations during the Idu earthquake of Nov. 26, 1930 (*Nature*, vol. 128, p. 155). Prof. T. Terada has recently studied about forty examples noticed in Japan (*Earthq. Res. Inst. Bull.*, vol. 9, pp. 225-255, 1931). They have indeed been seen with all recent great earthquakes in that country. In the Idu earthquake, they were observed to a distance of 50 miles east of the epicentre, 68 miles north, and 43 miles

west. At some distance, as in Tokyo, the lights were not unlike sheet lightning. The first flash was seen immediately after the first shock, then three or four others followed at intervals of from one to ten seconds, but the duration of each flash was longer than that of sheet lightning. Close to the epicentre, the light assumed more definite forms, in one case of a straight row of round masses. The colour was usually pale blue or white, and, even in Tokyo, the lights were bright enough to illuminate the objects in a room. Prof. Terada concludes that the phenomena are real, and suggests several causes, such as landslides, to which they may be due.

**Spectra of Negative Ions**—In a paper in the *Zeitschrift für Physik* for Oct. 14, Prof. R. Mecke makes the interesting suggestion that certain band spectra which appear when arcs are run in hydrogen between beryllium or magnesium poles, which had previously been supposed to be emitted from positive ions of the hydrides BeH and MgH, actually come from the negative ions of these compounds. His argument is based on the so-called displacement rule, which applies both to atoms and molecules, and states, for the latter, that molecules which possess the same number of electrons similarly arranged have closely similar spectra. If the bands of magnesium hydride in question were due to the positive ion, they should thus be similar to those of neutral sodium hydride, whereas they are in fact much more like those of neutral aluminium hydride. The beryllium hydride bands likewise resemble those of neutral boron hydride more closely than those of lithium hydride. The evidence presented is so striking that it seems that the only alternative to accepting these spectra as having their origin in molecules which have acquired an extra electron is to reject the displacement rule in relation to molecules. The importance of Prof. Mecke's discovery, if substantiated, is not merely spectroscopic, as it suggests that it may be profitable to investigate the quantum theory and chemical behaviour of negative ions, subjects which have received little attention.

**Crystal Photocells**—The first November number of the *Physikalische Zeitschrift* contains an article by Prof. W. Schottky on the electrical properties of crystals of cuprous oxide held in contact with a metal. This system can be used either as a rectifier for small alternating currents or as a photoelectric device, but whilst the former effect has been widely employed in crystal detectors, it was not known until quite recently that the contact could be disturbed by illumination, and that a current would flow under the influence of light even without an applied potential difference. As is shown in a number of other papers in this and the following number of the same journal, the effect depends both upon temperature and the frequency of the radiation, and it appears that it is primarily due to properties of the crystal rather than to those of the metal. It is not entirely a contact action, since Prof. Schottky has shown that the active layer of crystal is probably not less than  $1\mu$  in thickness, the large free paths for electrons which this calls for are, however, also required by other crystal phenomena, and can be readily accounted for on the wave mechanics.

**Viscosity of Nitrogen at High Pressure**—Some measurements of the viscosity of nitrogen are described by A. Michels and R. O. Gibson in the November number of the *Proceedings of the Royal Society*, which show how the properties of the gas approach those of a liquid when the density of the gas is made large compared with its atmospheric value. The measurements were made by the usual method of forcing gas through a capillary tube, but the apparatus was constructed so that it could be used at pressures

up to 1000 atmospheres. The results demonstrate immediately that the gas law (viscosity is independent of pressure) ceases to be valid at a few atmospheres pressure, the value of the viscosity changing by a factor of 2.5 over the whole range considered. Moreover, at pressures above about three hundred atmospheres the viscosity acquires the typical liquid property of increasing with decreasing temperatures if it is considered as a function of the pressure, although it continues to increase with increase in temperature if it is considered as a function of the density. A theory of the viscosity which has been proposed by Enskog can be tested from the results of these experiments, and leads to values for the diameter of the nitrogen molecule which lie consistently between  $2.9 \times 10^{-8}$  cm and  $3.0 \times 10^{-8}$  cm.

**Crystalline Rubber**—A short communication from E. W. Washburn in the first November number of the *Physical Review* contains the announcement that a group of workers at the United States Bureau of Standards have succeeded in obtaining a well crystallised hydrocarbon from typically colloidal rubber. This has been accomplished by dissolving purified rubber in a suitable solvent to form a dilute solution, and crystallising it out at rather low temperature. A photomicrograph is shown of some crystals which were grown at  $-55^\circ$  from a 0.05 per cent solution in ether. Their melting point has not yet been fixed definitely, but lies between  $-35^\circ$  and  $0^\circ$  C. The molten product has the appearance of ordinary rubber, and contains hydrogen and carbon with an atomic ratio closely eight to five. It has also been found possible to distil the rubber hydrocarbon, but fractionation by this process is relatively slow.

**Stream Lining in Locomotives and Motor Cars.**—Dr O. G. Tietjens contributes an interesting paper on stream line locomotive and car design to the fourth quarterly issue for 1931 of the *Westinghouse International*. He is a research engineer to the company, and his experiments on small locomotives and cars, accurate to the minutest detail, bring out very clearly the importance of stream line design. He finds that an electric locomotive travelling at eighty miles an hour requires five times as much power as when travelling at forty miles an hour. Even higher speeds are contemplated because the competition of aeroplanes and motor cars makes high speeds imperative. In the case of a heavy locomotive and two heavy coaches, stream line design saves thirteen per cent of the power at a speed of 35 miles an hour and thirty-two per cent at a speed of 75 miles an hour. It requires 286 horse-power to drive an interurban street car at a speed of 80 miles an hour. Tests made in the Westinghouse wind tunnel indicate that the same type of car constructed with stream line design can be driven at 80 miles an hour with only 140 horse-power. The power required in the latter case is less than one-half that required in the former. A method is shown of converting the modern American tram-car with its blunt ends, sharp corners, and hundreds of air pockets into a stream line car. A new front and a new rear are given to it, the roof is made smooth, the sides are extended downwards, and the recesses for the windows are eliminated. This reduces the wind resistance to one-third its former value. The new styles of high-speed locomotives and cars will probably soon become common, revolutionising the appearance of the car and greatly increasing its economy and efficiency in operation.

### Astronomical Topics.

**Astronomical Phenomena for January**—Occultation of Pleiades Jan. 18,  $\eta$  Tauri disappears 17<sup>h</sup> 4<sup>m</sup>, reappears 18<sup>h</sup> 3<sup>m</sup>, 27 and 28 Tauri disappear at 17<sup>h</sup> 45<sup>m</sup> and 17<sup>h</sup> 50<sup>m</sup> respectively.

Venus is an evening star, with about five-sixths of the disc illuminated, its meridian passage changes from 14<sup>h</sup> 5<sup>m</sup> to 14<sup>h</sup> 29<sup>m</sup> during the month.

Jupiter is approaching opposition, and is observable for most of the night. Mutual eclipses of the satellites (visible in England) occur on Jan. 3, 5, 7, 10, 12, 23, 24. Details are given in the B. A. A. Handbook.

Neptune is about  $15^\circ$  east of Jupiter, so it is also observable. It reaches opposition late in February.

Minima of Algol, at convenient hours of observation, occur on Jan. 4, at 22<sup>h</sup> 7<sup>m</sup>, Jan. 7, 19<sup>h</sup> 6<sup>m</sup>, Jan. 27, 21<sup>h</sup> 3<sup>m</sup>, Jan. 30, 18<sup>h</sup> 1<sup>m</sup>. Each eclipse begins about 4<sup>h</sup> 7<sup>m</sup> before these times, and ends 4<sup>h</sup> 7<sup>m</sup> after them. The interval between minima is 2<sup>d</sup> 21<sup>h</sup>.

**Moving Pictures of Celestial Objects**—When the cinematograph was invented it was seen that it might be usefully applied to celestial phenomena. Mr Maskelyne took a film of the total solar eclipse of 1900, which was exhibited at the Royal Astronomical Society, and the idea has been repeated at some later eclipses, especially at that of 1927.

The University of Michigan has founded an Observatory, known as the McMath-Hulbert Observatory, at Lake Angelus, Michigan, which devotes itself to the production of moving pictures of celestial phenomena. Vol. 4, No. 4, of the *Publications* of the University gives a description of the methods and results. The driving clock of the equatorial has a very accurate electrical control, there are arrangements for varying the speed of the film within large limits, as the objects photographed range from sunspots to faint variable

stars. There are devices for varying the clock drive, and giving motion in declination for films of moving objects such as the moon. These are also available for correcting for the variation of refraction as the altitude changes, some tables for this purpose are given in the report.

The possibilities of the method were well brought out in a film that was exhibited at the Royal Astronomical Society a few years ago, in which Jupiter was shown in rotation, and the approach of a satellite to the planet was also recorded. It would seem that a comet like that of Morehouse of 1908, in which the tail showed rapid changes, would afford a fruitful field for work with the instrument, unfortunately, such comets are rare.

**'Annuaire' of the Belgrade Observatory for 1932.**—This volume is issued by Dr V. V. Michkovitch, the director of the Observatory, being the fourth of the series. It has the honour of anticipating by a year the British Nautical Almanac in the introduction of the notation terms of short period in the ephemeris of sidereal time at Greenwich midnight, the time is also given to the third decimal of a second. These changes are consequential on the great improvements in clocks that have been made in recent years. The volume also contains ephemerides, at intervals of ten days, of 189 stars from Eichelberger's standard catalogue, these are not contained in other almanacs, and were calculated at Belgrade. Another feature, which must have been troublesome to compile, is a list of the 169 minor planets discovered between Nov. 2, 1929, and June 30, 1931, the dates and discoverers are given, also the dates of subsequent observations, and indications of those for which orbits have been computed.

## Principles of Field Experimentation.

THE science of field experimentation has developed rapidly during the last decade, and its ever-widening importance justified a Rothamsted conference devoted entirely to its principles and technique.<sup>1</sup> As was only fitting, the first paper was contributed by Dr R. A. Fisher, who detailed the three principles of modern field experimentation—replication, randomisation, and local control—and showed how these three are necessary in order to reduce, and to give a valid estimate of, the error which must always loom largely in this type of inquiry. Following this, Dr J. Wishart illustrated the calculations appropriate to randomised blocks and Latin squares, which have proved the most serviceable forms of lay-out.

Later speakers enlarged on a variety of subjects. It is clear from a perusal of the papers that the need is often felt for inquiries carried out at a number of centres simultaneously, so that different conditions of soil and weather may be encountered, and hence that the conclusions may be of general applicability, if each centre adopts the same form of lay-out (though with separate randomisation of treatments) then it is possible to combine all the results in one calculation and attain considerable precision, and still not lose the individuality of the results. Details were given of the methods which experience has shown to be the best for experiments located at a distance from the research station. In these cases a sampling method has proved satisfactory, not only as a means of making developmental studies but also to provide a reliable estimate of the final yield.

Particular cases necessitate special technique. Horticultural experiments introduce difficulty through the longevity of the plants concerned, with the concomitant danger of accident, and the problem of measuring the vigour of the plant. In the case of variety trials, the National Institute of Agricultural Botany still prefers the well-known 'Beaven's half-drill strip' method. The only paper on grass experiments was contributed by Prof. Stapledon, who described the methods adopted at Aberystwyth; he laid much less stress on the statistical adequacy of the technique than on botanical analyses and the problem of how the result should be measured and converted into terms of nutritive value. The papers deal fully

with all the working details, and together they provide a most valuable compendium of experience.

A number of examples of the precision and type of results which may be expected from modern field experiments is contained in the Rothamsted Report for 1930.<sup>2</sup> The majority of problems attacked are manual ones, and the complex lay-outs used give very detailed information. The response of the crop to two or three plant foods, each in varying amounts, can be tested in one and the same experiment, and, if occasion arises, this can be combined with inquiry into the different forms in which any nutrient can be supplied, or the responses of different varieties of the crop plant.

The reader is soon convinced of the necessity for complex experiments, for it is evident in nearly all cases that incomplete inquiry might give misleading results. As an example, it was found that potatoes only responded appreciably to potash and to large doses of nitrogen when a sufficiency of phosphate was supplied, and that superphosphate provoked more than three times as much response in the presence of plenty of nitrogen and potash as it did in the absence of dressings of these two nutrients. Relations of this type appear again and again, making the conclusions difficult to state in a simple manner: there is always a danger in these intricate cases that the reader may 'miss the wood for the trees', but in general the report is admirably and lucidly expressed.

The height of complexity is reached in two rotation experiments which were initiated in 1930: these will yield results year by year, but for their full completion they need twenty years and thirty years, respectively. The Report also contains a brief description of the work proceeding in the laboratory, and summaries of papers recently published by the staff; it is a valuable volume to workers in agriculture and the allied sciences.

H. G. SANDERS

<sup>1</sup> 'The Technique of Field Experiments' being the Report of a Conference held at Rothamsted on May 7, 1931, under the chairmanship of Sir A. D. Hall, with contributions by Sir A. D. Hall, Sir John Russell, Dr R. A. Fisher, Dr J. Wishart, Prof. R. G. Stapledon, S. F. Armstrong, A. H. Lewis, T. N. Hoblyn, H. V. Garner, D. J. Watson, T. H. J. Carroll, and others. Pp. 64 (Harpden Rothamsted Experimental Station, 1931) 1s 6d net.

<sup>2</sup> Rothamsted Experimental Station, Harpenden, Lawes Agricultural Trust Report for 1930. Pp. 172 (Harpden Rothamsted Experimental Station, 1931) 2s 6d.

## The Coal Measures of Belgium.

IN several Continental countries the geology of the coal measures has for long received great attention. This is especially true of those coalfields where the rocks are highly disturbed and the interpretation of the geological structure is often a matter of great difficulty.

In Belgium a succession of brilliant workers has applied palaeontological methods to the elucidation of the sequences and structures in the coalfields. Lately this work has been carried out under the direction of Prof. A. Renier, of Brussels, whose contributions to the geology of the Carboniferous of Belgium have been widely known for many years. In a recent memoir, Prof. Renier has summarised the development of these investigations, and has given a concise account of his views concerning the mode of deposition of the rocks and of their correlation, while Prof. Pierre Pruvost, of Lille, has contributed to the memoir a very valuable account of the fauna.\*

\* Considérations sur la stratigraphie du terrain houiller de la Belgique, par Armand Renier, La Faune continentale du terrain houiller de la Belgique, par Pierre Pruvost. *Mém. Mus. Roy. d'Hist. Nat. de Belg.*, No. 44, 1931.

Prof. Renier asserts that in the coal measures of Belgium the floor of every seam is full of the footlets of *Stigmara*. The plant remains of these fossil soils are of very monotonous aspect, *Stigmara ficoides* being present at every horizon throughout the sequence. Renier emphasises that the tracing and recording of such fossil soils, even when they are, locally, not overlain by coal seams, is of great assistance in the investigation of the strata. This is in marked contrast with the general practice in many mining areas in Britain, where frequently there have been no records of any of the strata passed through excepting the coal seams.

Renier directs attention to the wide lateral extent of many coal seams, while at least one marine bed in the coal measures he recognises in areas so far apart as the Pas de Calais, Holland, and Westphalia. This wide extent of at least some beds in the Upper Carboniferous strongly supports the view that there was at times continuous deposition over wide areas. The views formerly held by some geologists regarding the deposition of the coal measures in small isolated basins,

more or less co-extensive with the present coalfields, receive no support from Renier's work

In contrast with the uniformity of the floors of the coal seams, the roofs yield extremely varied faunas and floras. These have been examined and recorded with great precision. Renier quotes approvingly the words of Crépin, who laid down two rules for palaeontologists working on the coal measures so long ago as 1878. Palaeontologists, he advised, should never confine their researches to material collected from the rubbish tips of collieries, but should themselves descend the mines and study the Carboniferous vegetation *in situ*, further, they ought not to leave the collecting exclusively to workmen and others ignorant of the science, but to undertake some of the labours themselves.

The neglect of this advice—not only in Belgium—led for many years to serious errors in regard to the palaeontology of the coal measures. Thus, Prof. Renier shows that certain palaeontologists who have studied the coal measures of Belgium since Crépin's time based their conclusions almost entirely on museum collections, and decided that the flora was uniform in character from top to bottom of the sequence, recent work, on the other hand, based on the actual examination of each horizon, has made it clear that distinct floras can be recognised and used both in the identification of seams and in the correlation of the coal measures over western Europe.

Prof. Pruvost's account of the non-marine faunas

makes a fitting sequel to his monumental work on the faunas of the coal measures of the north of France. A beautiful series of plates is devoted chiefly to the fossil insects and other arthropods and to the fishes. A number of remarkable fossils is described, and this part of the memoir will be indispensable to all students of coal measure palaeontology. It is much to be regretted that no illustrations of any of the Mollusca are included (except in relation to their supposed borings), the Mollusca are much more frequent than other fossil animals at most horizons, and Pruvost relies on them to a great extent in his correlation.

Pruvost is not prepared, however, to accept any of the refinements in nomenclature which have been made in recent years. To a large extent he has followed the late Dr. Wheelton Hind, who was very conservative (and sometimes, unfortunately, rather inaccurate) in his interpretation of these species. But whereas even the latter was willing to recognise some twenty-five species of non-marine lamellibranchs in the coal measures of Belgium, Pruvost admits no more than twenty. In his 'lumping' of species he places *Anthracomya librata* Wright as a synonym of *Carbonicola similis* Brown, and *Naradites elongata* Hind as a synonym of *Anthracomya philipsi* Will. It is probable that his discrimination of the faunas is much more precise than the nomenclature which he uses, but his method must make it difficult for other palaeontologists to make full use of his labours.

A. E. TRUEMAN

### Dyestuffs and Enzymes.

MANY dyes and related compounds have a specific toxic effect on certain micro-organisms which has been utilised in the treatment of the diseases caused by them. The mode of action of the dyestuff is not known, but it is probable that it poisons some particular system in the cell, without which the latter cannot carry on its metabolic activities.

Some recent researches by J. H. Quastel on the action of dyes upon enzymes may throw light not only on the nature of the toxic effect, but also on the constitution of the enzymes employed (*Biochem Jour*, vol. 25, p. 629, 1931 (with A. H. M. Wheatley), and *ibid.*, vol. 25, pp. 898 and 1121, 1931). In the first paper it was found that basic, but not acid, dyes inhibited the oxygen uptake by *B. Coli* in the presence of glucose, lactate, succinate, and formate. The degrees of inhibition varied both with the dye and the substrate used, so that the effect could not be due to a general lethal action. Since it is the basic dyes which are active, it appears that the cell dehydrogenases are essentially acidic in character, but basicity is not the only factor in toxicity, since the basic Bismarck brown has little action. The inhibitory action of the dye was less marked in phosphate than in veronal buffer. Similar results were obtained with muscle enzymes, but no inhibition was observed with any dye when brain tissue was used, probably because the dye failed to reach the enzyme.

In the second paper, the behaviour of fumarase from micro-organisms or from brain or red-blood cells

was studied. This enzyme converts fumarate to l-malate, which can be estimated polarimetrically. It was found that both acid and basic dyes were toxic, but a marked specificity was apparent, of the former, the Congo red series was the most toxic, of the latter, the triphenylmethane series. It was also observed that fumarate combines with its enzyme and prevents the combination, and hence the toxic action, of both acid and basic dyes, that proteins exert a protective action, and that the protective action of phosphates is less than in the case of the dehydrogenases.

The most recent experiments have been carried out with certain naphthylaminedisulphonic acids and fumarase, after observing that trypan red and Bayer 205, like Congo red and trypan blue, are toxic. None of the six acids tested were toxic, nor were their first *s*-carbamide derivatives. The second and especially the third *s*-carbamide derivatives were, however, very toxic, that is, the *s*-carbamides of *m*-aminobenzoyl-naphthylaminedisulphonic acid and of *m*-aminobenzoyl-*m*-aminobenzoylnaphthylamine-disulphonic acid. The importance of this observation lies in the fact that there is a definite, though not strict, parallelism between the toxic action of these carbamides on fumarase and their trypanocidal potency, as determined by Balaban and King. It is possible that this method of investigating the toxicity of dyestuffs on enzymes may prove suitable for preliminary tests in the preparation of compounds likely to be of chemotherapeutic value.

### Carbonisation of Coal.

GRATE expectations have been placed upon coal carbonisation at low temperatures as a source of motor spirit. Fuel Research Technical Paper No. 34 (H.M.S.O., 6d net), on the "Light Spirits from the Low Temperature Carbonisation of Coal", shows that the experience with benzole production cannot be directly transferred to low temperature products.

The proportion of tar acids and unsaturated compounds is higher, necessitating greater consumption of chemicals in refining. The refined products were found by actual tests in petrol engines to be good motor fuels at least equal, when fresh, to commercial petrol. They still contained considerable quantities of unsaturated compounds which were liable to polymerise.



on storage and they show increased gum and peroxide formation, accompanied by decrease in the highest useful compression ratio (H U C R). The report suggests the need for caution in assessing the value of low temperature processes as sources of motor fuel.

The pioneers of low temperature carbonisation seemed to take it for granted that the tars and oils produced would find markets ready for their absorption. Even now, this idea is still widespread. Experience brought disillusion, and it became clear that only after long research could one expect to develop uses for these novel products. Among other institutions the Fuel Research Station has studied systematically the influence of conditions on the general character of the tars and liquors. A more detailed chemical study of the tars was undertaken by the National Chemical Laboratory at Teddington with the view of discovering, if possible, new industrial applications for these products.

Much of this work has been published in periodicals and is now included in a Fuel Research Technical Paper No. 32, entitled "A Study of the Tars and Oils Produced from Coal" (H M S O., 2s net). This is in four parts—statistics, the treatment of low temperature tars from a commercial retort, the carbonisation of three British coals at varying temperatures, and

the influence of temperature on the properties of tars. Perusal leads to the conclusion that in the development of low temperature processes too much capital has been spent on large scale plant, and too little on laboratory investigation of the chemistry of the processes and their products.

One branch of the work of the Fuel Research Board is the physical and chemical survey of national coal resources, which now covers practically the whole of the British coalfields. The reports hitherto published have dealt with the detailed survey of seams of coal. Paper No. 20, which has just appeared (H M S O., 1s 3d net), entitled "The Yorkshire, Nottinghamshire and Derbyshire Coalfield, Analysis of Commercial Grades of Coal, Part I", breaks new ground by giving the analyses of the commercial products of about forty important collieries in the district. It can scarcely be doubted that the information will be of great use to those concerned with the selection and purchase of coal, whether at home or abroad. The report should also be of great value to the collieries concerned, and will excite envy in other industries not so fortunate as to have their products so examined and certified. Perhaps the most striking impression which the reader can gain from the figures is the high quality of the fuel marketed in this area. Most of the samples contain less than five per cent of ash.

### High Speed Flying.

AT an evening discourse delivered before members of the British Association on Sept. 29, Mr. H. E. Wimperis, Director of Scientific Research to the Air Ministry, gave an interesting résumé of accomplishments, and speculations as to future advances, in high speed flying. The very high accelerations set up have given rise to various problems, both structural in the aircraft and physiological in the occupant. A rate of three times that of gravity can be obtained in starting by the use of catapults. These are necessary for obtaining the minimum speed for flight for fast machines in a reasonable space. It is interesting to note that this rate of increase of speed is about a hundred times that of a steam-engined railway train. Even greater accelerations are experienced in curved flight—up to five times gravity—and as the machine is only designed to withstand a load of 8g, care has to be exercised, in making rapid turns of small radius, not to approach this. The centrifugal force on the pilot in such turns drives the blood from his brain to the more distensible parts of his body, and this is accompanied by a loss of sight, although not of mental clarity.

Such high speed machines are necessarily built as seaplanes, as it is impossible to make aerodromes with sufficiently flat surfaces, or large enough, to allow of reaching the very high minimum flying speed with safety. Even on smooth water, handling requires

considerable skill, as the angle at which the floats will leave the water due to hydro-planing is greater than the machine can maintain when it becomes air borne. Another peculiar trouble arises from the fact that at speeds of above 360 m.p.h. the rush of air actually heats a body passing through it, instead of cooling it. This complicates the question of cooling both the engine and the pilot's cockpit.

With regard to future progress, while there is no theoretical limit to speeds higher than 407.5 m.p.h., the present record, there are many practical difficulties to be overcome. Better streamlining would give up to another 60 m.p.h. for the same power, but some excrescences which spoil this, such as the undercarriage, tail, etc., appear to be inevitable. At the velocity of sound, namely, about 700 m.p.h., there is a doubling of the head resistance, which would appear to be an insurmountable barrier to aircraft of the present form, but with other aerodynamic outlooks this may be passed.

Another method of reducing resistance would be to fly at altitudes of, say, 100,000 feet, where the reduced density of the air would offer less resistance to motion. This would probably need some form of rocket propulsion, as the present-day engine would not function without a sufficient supply of oxygen, neither would the propeller have enough bite on the thin air to transmit the necessary thrust.

### Hardening of Metals in a Magnetic Field.

MR. E. G. HERBERT, of Manchester, contributed a paper to the Royal Society in January 1931 and two articles to *Metalurgia* in May and June of last year on the hardening of metals in a magnetic field. The Royal Society paper describes the fluctuations in the hardness of steel, duralumin, and brass caused by rotation in a magnetic field. Mr. Herbert shows that the time element is an important factor in the hardening produced magnetically. He has found that the hardness changes are sometimes very rapid, and in hard steel, freshly treated, changes may sometimes be observed from minute to minute.

Later research has shown that the effect produced in steel by the magnetic treatment is periodic in character, generally extending over many hours subsequent to treatment. In some experiments there were a sequence of six alternate increases and decreases of hardness occupying gradually lengthening periods of time. It was found that when a rotary magnetic field was used the maximum hardening effect could be produced by a single turn in the magnetic field at a suitable temperature followed by a period of ageing. The cloud-burst process of hardening by steel ball bombardment could be superimposed on the

rotating field method, the processes being apparently independent of one another

Mr Herbert adopts as a provisional theory that the rotating magnetic field gives rise to a fluctuation of a periodic character in the systems of electrons, which in turn causes periodic fluctuations in molecular cohesion. A very interesting possibility of a practical nature follows from these investigations, namely, the stabilisation of the metal at a selected phase in the fluctuations set up mechanically, magnetically, or otherwise. For example, the stabilisation of steel wire in a condition characterised by greatly increased ductility with undiminished tensile strength.

In *World Power* for October, Mr Herbert describes some work in connexion with high-speed tools. At present the results obtained seem very anomalous, in some cases the magnetic field has a hardening effect on the metals experimented on, and in other cases it softens them. The results suggest that the magnetic effects have been merely superimposed on the normal age-hardening process. They may be quite different in character. A softening magnetic process added to age hardening might be expected to slow down the hardening process, while a hardening magnetic treatment added to the normal hardening might be expected to accelerate it. It was observed that an increase of hardness equivalent to an increase of 13 per cent on the Brinell scale was induced in high-speed steel by a single turn of the magnetic field, occupying about a minute and applied at a temperature of only 100° C. Such a treatment could easily be given to finished tools of the most complicated character as well as to drills, sawblades, and dies in which a high degree of hardness is desirable. It is probable that further experiments, especially as to what is the best temperature to employ, will give even better results. As no metal hitherto subjected to magnetic treatment has failed to react, it is possible that these effects are common to all metals. In the non-magnetic metals the hardness changes hitherto produced have been relatively slight, but research in this direction seems very promising. It has been suggested that these changes may not be confined to metallic or even to inorganic substances.

### University and Educational Intelligence.

LONDON.—Dr F. A. von Hayek has been appointed for the session 1931–32 to the Tooke chair of economic science and statistics tenable at the London School of Economics.

The following titles have been conferred in respect of posts held at the Colleges indicated: *Professor*—Dr Charles Singer (history of medicine, University College), Mr E. F. D. Witchell (mechanical engineering, Imperial College—City and Guilds College) *Reader*—Mr R. J. Tabor (botany, Imperial College—Royal College of Science), Dr W. G. Bickley (mathematics, Imperial College—City and Guilds College), Dr G. F. J. Temple (mathematics, Imperial College—Royal College of Science), Mr B. W. Holman (mining, Imperial College—Royal School of Mines), Dr Herbert Dingle (physics, Imperial College—Royal College of Science), Dr H. S. Gregory (physics, Imperial College—Royal College of Science), Dr S. G. Paine (plant bacteriology, Imperial College—Royal College of Science), Mr J. P. Ross (surgery, St Bartholomew's Hospital Medical College), Dr L. C. Martin (technical optics, Imperial College—Royal College of Science), Dr Elizabeth A. Fraser (zoology, University College).

The title of emeritus professor in the University has been conferred on the following.—Prof E. J. Garwood, on his retirement from the Yates-Goldsmid chair of

geology at University College, Prof C. Spearman, on his retirement from the chair of psychology at University College, Prof W. E. Dalby, on his retirement from the chair of civil and mechanical engineering at the Imperial College—City and Guilds College.

The degree of D.Sc. in biochemistry has been conferred on Bireschandra Guha for a thesis entitled "Investigations on the Factors of the Vitamin B Complex and on the Newer Factors necessary for the Normal Nutrition of the Rat" (*Brit. Med. Jour.*, 1931, and *Biochem. Jour.*, 1931).

For the session 1931–32, the Department of Coal Gas and Fuel Industries with Metallurgy of the University of Leeds has arranged a series of evening courses, with practical work. The courses comprise studies in the manufacture of coal gas, refractory materials, the coke fire, and metallurgy. Further information can be obtained from the Registrar, University, Leeds.

THE professional education of teachers in the United States of America during the past ten years is reviewed in *Bulletin*, No. 30, 1931, of the Office of Education, Washington. One of the most striking changes brought to notice is in the relationship between the demand for and supply of certificated teachers. The number of students in training for teaching increased from 135,435 in 1919–20 to 274,348 in 1927–28, the number of students completing one-, two-, and three-year curricula during the same time increased from 21,012 to 49,627, whilst those graduating after a four-year course increased from 1296 to 8179. The oversupply of teachers in many places and the overcrowding in a few teachers' training institutions have led to the raising of the standard of requirements for admission to teacher-training courses. There has been also rapid progress in raising standards of certification. The average number of students per training institution has grown from 439 to 877, necessitating better facilities for their social and physical welfare. Of the strictly professional courses, student teaching is coming to be recognised as one of the most important, and it is much more frequently provided than formerly, but probably fifty per cent of teachers enter upon their duties without having been through such a course. Training colleges are increasingly concerning themselves with the careers of their graduates, and recognising an obligation not only to see them placed but also to help them in overcoming their inevitable difficulties during the first year or two of teaching.

COMMONWEALTH Fund fellowships will be available early in 1932 for British students who desire to continue their studies in American universities. Last year there were 121 candidates (99 men and 22 women) for ordinary and Dominion fellowships, and 29 fellowships were granted, 56 candidates applied for service fellowships (open to those in government service only), and 6 appointments were made. Of the 35 fellows appointed, 20 came from faculties of science. These fellowships are available to research graduates and also to students who have just taken their first degree. There is no fixed stipend attached to a fellowship, but each is of the approximate annual value of 3000 dollars. Each fellowship includes provision for an equipment allowance of 200 dollars, and a travel allowance, tuition fees, etc., 150 dollars per month for living expenses, allowance for travel during the Christmas recess, and allowance for three months' travel (which is compulsory) at the end of the first academic year. A fellowship is tenable for two years, with possible extension to a third year. There is very little limitation to the subject of study which a fellow may choose. Applications for fellowships must be

sent to the authorities of the college or university of which the candidate is, or has been, a member, and must reach the Secretary by Feb 8, 1932. Further information can be obtained from the Secretary, Commonwealth Fund Fellowships, 35 Portman Square, London, W 1

### Calendar of Geographical Exploration.

Jan 1, 1841 — The Antarctic and the Ice-Barrier

Under the direction of Capt J Clark Ross, R N, an expedition consisting of two ships, the *Erebus* and the *Terror*, crossed the antarctic circle to prosecute surveys for the British Government. From the point of view of geographical discovery, this was the most fruitful of all antarctic voyages. Ross was an experienced arctic traveller and had located the north magnetic pole in 1831. Under his direction, ships for the first time deliberately pushed their way into the pack ice. This ice, previously thought to stretch on indefinitely to the remote land, proved to be a belt about a hundred miles wide, and the *Erebus* and *Terror* passed through it to open waters now known as Ross Sea. By Jan 11, Ross had sighted the rocky coast of South Victoria Land and had noted the Admiralty Range running north-west along the coast, and a further range going southwards. Unable to reach the mainland, he landed on Possession Island and claimed the newly discovered land for Britain. Later he sighted an active and an extinct volcano, named respectively *Erebus* and *Terror* after the vessels. The great ice barrier, with peaks 200 ft - 300 ft in height and extending for 250 miles, seen for the first time, checked his farther southward progress. Like the Frenchman, Dumont d'Urville, who had set out from Hobart on Jan 1 of the previous year, he was compelled to give up the dream of reaching the south magnetic pole, though he penetrated nearer to it than any previous explorer.

Sixty-one years later, on Jan 1, 1902, the *Discovery*, with Lieut R F Scott, R N, as its commander, and with E H Shackleton, R N R, as one of its lieutenants, met the pack ice and thence penetrated to Ross Sea. The ice-barrier had retreated 30 miles since Ross was there. Scott found that the land which Ross had believed to be east of the ice-barrier, but which he had cautiously charted as an "appearance of land", was plainly visible, its higher summits rising 2000 ft - 3000 ft. above the sea. It was further discovered that McMurdo Bay, charted by Ross, was in reality the opening of a strait leading southwards between Ross Island and the mainland. Mt *Erebus* proved to be not on the mainland, but on what is now mapped as Ross Island.

Jan 2, 1923 — The Libyan Desert

A M Hassanain Bey left Sollum, a small port on the Mediterranean near the western frontier of Egypt, on his difficult journey southward through the Libyan desert to Darfur. As a result of his work important new facts about the orography and geology of the region were recorded. His discovery of the rock basin oases of Arkenu and Owenat makes possible further desert travel in the still unexplored regions of the Libyan desert. His route linked up with Tilho's explorations in the French Sudan and confirmed the latter's conclusion that Lake Chad has no possible drainage outlet in an easterly direction.

Jan 7, 1830 — The Murray River

Charles Sturt launched a boat on the Murrumbidgee and sailed thence along the Murray to the sea. He had previously discovered a portion of the Darling River, this second "bold and desperate" venture solved the nature of the inland river drainage of south-eastern Australia.

### Societies and Academies.

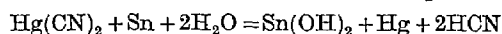
#### CAMBRIDGE

Philosophical Society, Nov 23 — T M Lowry and C B Allsopp. Refractive dispersion and the problem of 'optical exaltation'. A thin film of liquid is placed between the plates of a quartz etalon and the interference bands are focused on the slit of a spectrograph. The order of the interference bands is deduced from pairs of refractive indices determined with a refractometer. Refractive indices can then be deduced to four places of decimals in the visible or ultra-violet regions up to the limit of transparency of the film — T M Lowry and H K Gore. Optical rotatory power of vapours. Measurements have been made of the rotatory dispersion of camphor and of camphorquinone as vapour and in solution. In the region of absorption, camphor gives a curve with a composite maximum. This is explained by the composite character of the ketonic absorption band, as evidenced by the fact that the curve of circular dichroism covers a smaller range of wave-lengths than the absorption curve — T M Lowry and H Hudson. Absorption and circular dichroism of optically active substances. Measurements have been made of the absorption, circular dichroism, and rotatory dispersion of a series of bornyl xanthates. The two absorption bands are optically active but of opposite sign. The curve of circular dichroism therefore crosses the axis, as is observed experimentally in the methyl xanthate — C P Snow. Fine structure of absorption bands in crystals. The absorption bands of compounds of the rare earths in the crystalline state show well-marked discontinuities similar to the line spectra of the atoms. This has recently been shown to be due to the 'shielding' of an inner incomplete electronic group throughout the series of the rare earths. There is a marked sharpening of the lines when the crystals are cooled to liquid air temperature and below. Reasons for this have been discussed (see Snow and Rawlins, *NATURE*, 125, p 349, 1930) — R G W Norrish. Predissociation in relation to photochemical activity. A large group of primary photochemical effects may be correlated with the condition known as predissociation in the molecular absorption spectrum. With aldehydes and ketones, however, although photodecomposition coincides with predissociation, it is difficult to envisage the mechanism of the change, since the chemical data for some fifteen examples indicate that no free radicals are produced. It would appear that molecular rearrangement involving more than one bond occurs within the molecule.

#### PARIS

Academy of Sciences, Nov 23 — H Vincent and L Velluz. The immunogenic properties of the duodosalicylic cryptotoxin. From experiments on guinea-pigs, it has been proved that the duodosalicylic cryptotoxin, the preparation of which is given, is capable of rapidly conferring immunity against pure tetanus toxin. This cryptotoxin neutralises the tetanus toxin, the latter not being destroyed but converted into a harmless complex. This non-toxic complex rapidly immunises animals — C Sauvageau. The third kind of plurilocular organs of *Ectocarpus secundus* — Paul Montel. The upper limit of the moduli of the zeros of polynomials — Eduard Čech. The theory of dimensions — Maurice Janet. The minimum of the ratio of certain integrals — J A Lappo-Dandilevski. The decomposition of the normal integral matrix of a system of linear differential equations and the construction of the primitive

matrix—Jacques Devisme Some partial differential equations—Abramesco The Leja factor of uniform convergence of a series of polynomials—R Mazet The unity of the solution of problems of friction—Constantin Woronetz Lines of slip on a cylinder—J Baurand Periodic waves at the surface of water—Louis Bréguet Aerodynamic suspension of the aerial vehicle—J Dufay and R Gindre α-Herculis, a variable star of very small amplitude Previous observations on this variable star have given discordant results The photometer used in these observations gives an accuracy of about a hundredth of a magnitude, and 136 photometric comparisons were made The results are given in the form of a curve, showing a period of 22 days The form of the curve corresponds to a double star with eclipses—F Link and J Devaux The photometric and actinometric study of the moon during the eclipse of Sept 26, 1931—Paul Woog, Jean Givaudon, and Mlle Emilie Ganster Neutralising varnishes, properties of orientation of their superficial molecules Molecular polishing By the application of certain varnish coatings, lubricating oil can be prevented from spreading out over solid surfaces The composition and mode of treatment of such a varnish are given, and the theory of the process is discussed—Guy Emschwiller The mechanism of the photolysis of the alkyl iodides Either of the two theories, dissociation or activation, affords an explanation of the phenomena observed in the photolysis of the alkyl iodides—D K Yovanovitch and P Savitch The calorimetric study of the absorption of the γ-rays of radium Instead of the usual ionisation method, the authors use a microcalorimeter A null method is used, the heat produced by the radium being balanced by electrical heating Curves are given showing the heat developed by absorption in lead, silver, and copper—Mlle M Th François The anomalies observed when using benzene and nitrobenzene in cryoscopy It is usually held that benzene and nitrobenzene possess two *K* constants, one normal and applying to most organic substances, the other abnormal (hydroxyl compounds), practically half of the first The author's experiments cited do not confirm this—Augustin Boutaric and Charles Tournour The study of colloidal solutions by the polarisation of the light diffused by them For extremely small spherical particles, the theory of Lord Rayleigh shows that the diffused light should be totally polarised if the particles increase in size, the proportion of polarised light should be reduced Hence the study of the polarisation gives interesting information concerning the changes in a colloidal solution approaching the condition of flocculation—G Austerweil The preparation and purification of salts by the use of zeolites—J Golse The reduction of mercuric cyanide by tin in the presence of certain metallic salts Although tin is without action upon neutral solutions of mercuric cyanide, when sodium chloride (or certain other salts named) is added, hydrocyanic acid is set free, and the mercury is reduced to metal in accordance with the equation



—Ernest Kahane The possibility of destroying considerable quantities of organic substances by means of perchloric acid After a preliminary treatment with a mixture of nitric and sulphuric acids, and driving off water and excess of nitric acid, the perchloric acid is added drop by drop, the liquid being maintained at 190° C The oxidation is rapid and complete—E M Bellet The reaction between esters and alcohols in a slightly alkaline medium—Andre Kling and Daniel Florentin The mode of action of hydro-

genating and mixed catalysts in the hydrogenating cracking of phenols—Dalloni The geological constitution of Tibesti The pre-Cambrian substratum—H Le Breton The coast-line of post-neolithic age in Xu-Nghé and in Trois-Quang of the north (Annam, French Indo-China)—Chadefaud The morphological signification of the stigma of the zoospores and the zoogametes in the Heterokontæ and Phaeophyceæ—Théodore de Camargo The influence of the potash-nitrogen ratio on the development of the coffee plant during the first period of growth—Emile F Terroine and Mlle Germaine Boy The distribution of the nitrogen compounds of the urine in the minimum endogenous nitrogen consumption and in protein nutrition the problem of existence and of the magnitude of the albuminoid reserves—Mlle Marcelle Lapique Chronaxy of subordination in an invertebrate—Mme. H Heldt Observations on the laying, fertilisation, and the first stages of development of the egg in *Penaeus carinatus*—Maurice Piettre Remarks on the physical state of the calcium phosphates in milk the fractionation of their micelles leads to the existence of free calcium caseinate and of a calcium phosphate compound By physical means, centrifugation, freezing, and especially by dialysis against water, glycerol or saccharose, increasing proportions of calcium phosphate can be separated, and by using sodium citrate a casein can be obtained containing only traces of lime Hence it is concluded that in milk the colloidal lime exists as the triphosphate—Bordier A new helioactinometer The amount of iodine set free from a solution of iodoform in chloroform under the influence of the solar photochemical rays is taken as a measure of the light received—J André Thomas The production of tumours of sarcomatous appearance in the annelid *Nereis diversicolor* by inoculation with *Bacterium tumefaciens*

#### GENEVA

Society of Physics and Natural History, Nov 5—P Rossier The spectral sensibility of photographic plates The author gives an analytical expression for the sensibility curve of the photographic plates used at the Geneva Observatory This expression allows the study in some detail of certain applications of these plates to astronomical photometry—E Briner, H Paillard, and R Zurcher Attempts at supplying an internal combustion motor with air mixed with ozone In spite of the very low concentrations (about 1 in 10,000) in which it was introduced into the gas, ozone produced 'knocking' On account of the peroxidising properties of ozone, the effect noted appears to support the theory attributing detonating combustion to the formation of very unstable intermediate peroxides—R Wavre The small vibrations of liquid stars The author applies the 'uniform method' to the study of the small movements of stars composed of a nucleus and a fluid envelope Assuming the solid nucleus, he arrives at the results of Lord Kelvin concerning the oceanic tides The contrary assumption of a liquid nucleus is a new problem which he has succeeded in solving He develops also the influence of the terrestrial tide on the oceanic tide and gives the principal results

#### LENINGRAD

Academy of Sciences—*Comptes rendus*, No 7, 1931—N Tagejeva and F Starik The radium content of the petroliferous waters of Tchelenen island The water contains from  $6.75 \times 10^{-11}$  to  $4.37 \times 10^{-11}$  gm of radium in 100 cc of water—L Kurbatov The radioactivity of the mineral water of Nefte-dagh and Tchelenen—V Baranov and L Kurbatov The radium

content of the petroliferous waters in the Grozny district. The radium content of water in July-September proved to be considerably less than in March of the same year—L Komlev. The radium content in the water of oil wells in the Novo-Grozny district. Beginning with July 1929, a marked reduction on the radium content was observed, although the general chemical content of the water remained practically unchanged—V Ignatovskij. Functions which are orthogonal to the hypogeometrical series (1).

*Comptes rendus*, No 8, 1931.—A Fersman (1) A geochemical diagram of the Chibim mountains—(2) The geochemistry of gold—D Priamishnikov. The formation of ammonia during the reduction of nitrates by the higher plants. Normal plants absorb ammonia more energetically than nitrates—A Popov. A new genus of fish, *Davidjordania* (Zoaridae), from the Pacific Ocean. *Lycenchelys lacertinus* Pavl is made the type of a new genus, to which *L ornatus* Sold and *L pæcilumen* Jord and Fowl are also referred. *Lycenchelys brachyrhynchus* Schm belongs to the genus *Hadropareia*, and *L fasciatus* Schm is a synonym of *Lycodes fasciatus* Schm—V Scherbina. Chemical constitution of the nepheline from the Chibim mountains.

## SYDNEY

Royal Society of New South Wales, Sept 2—H Finemore and C B. Cox. The amount of hydrocyanic acid in *sorghum* sudan grass and some hybrids. *Sorghum* contains a higher amount of prussic acid than has been hitherto recorded, and it loses this acid as the plant develops, but even on cutting and wilting the young plant by no means becomes innocuous. Of the results obtained, it was shown that the variety *Feteritis* is the most poisonous. Contrary to opinions held in some quarters, it was found that sudan grass contains an appreciable amount of prussic acid—F R Morrison and R Grant. A contribution to the chemistry of the fruit obtained from the White Cedar tree (*Melha Azedarach*, L var *australasica* C DC; Syn *Melha australasica*, A Juss) growing in New South Wales, with notes on its reputed toxicity. Proximate analyses of the fruit were obtained from trees growing at Grafton and Dubbo, New South Wales, respectively. The ripe fruit obtained from Grafton trees contains a sticky pulp, consisting of a starchy meal, a resin, an oil, and dextrose, with acid and other water-soluble substances. Feeding tests using guinea-pigs showed the Grafton fruit to be non-toxic, whilst fruit from trees growing at Dubbo and Parramatta, respectively, proved in some cases to contain a toxic constituent, which was found to be present in the resinous portion of the fruit. A very small quantity of basic material was extracted from an ether solution of the resin by means of 0.5 per cent sulphuric acid solution. Neither the basic extract nor the resin from which it was extracted produced toxic symptoms when administered alone, but a mixture of both produced fatal results.

Oct 7—J C Earl and C H Wilson. The condensation of  $\alpha$ - $\beta$  dibromocarboxylic acids with benzene in the presence of aluminium halides. Cinnamic acid dibromide and crotonic acid dibromide when treated with aluminium chloride and benzene give the corresponding derivatives of dihydrophenanthrene. By the use of ferric chloride or aluminium bromide, instead of aluminium chloride, linking between the two phenyl nuclei does not take place,  $\alpha\beta$ -tri-phenylpropionic acid and  $\alpha\beta$ -diphenylbutyric acid being formed from the cinnamic and crotonic acid dibromides respectively.

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## Diary of Societies.

## FRIDAY, JANUARY 1

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 3.30—E R Jarrett. Christmas Juvenile Lecture on Architecture.  
ROYAL PHOTOGRAPHIC SOCIETY, at 7.  
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.

## SATURDAY, JANUARY 2

ROYAL INSTITUTION OF GREAT BRITAIN, at 3—Sir William Bragg. The Universe of Light (Christmas Lectures) (3).  
Light and Colour (1).

## MONDAY, JANUARY 4

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.  
INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales—Liverpool—Centre) (at Liverpool University), at 7.  
INSTITUTION OF RUBBER INDUSTRY (at Engineers' Club, Manchester), at 7.  
WOLVERHAMPTON AND DISTRICT ENGINEERING SOCIETY (at Victoria Hotel, Wolverhampton), at 7.30.  
BRITISH KINEMATOGRAPH SOCIETY (at Gaumont Theatre), at 7.45.  
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.  
SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.

## TUESDAY, JANUARY 5

ROYAL INSTITUTION OF GREAT BRITAIN, at 3—Sir William Bragg. The Universe of Light (Christmas Lectures) (4).  
Light and Colour (2).  
INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.  
INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.

## WEDNESDAY, JANUARY 6

ROYAL SOCIETY OF ARTS, at 3—Prof E N da Costa Andrade. The Vacuum, or the Importance of Nothing at All (Dr Mann Juvenile Lectures) (1).  
INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.  
INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.  
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street, W C 1), at 7.  
INSTITUTION OF AUTOMOBILE ENGINEERS (at Queen's Hotel, Birmingham), at 7.30.  
INSTITUTE OF BREWING (North of England Section) (at Midland Hotel, Manchester).  
ROYAL MICROSCOPICAL SOCIETY (Biological Section) (at B M A House, Tavistock Square).

## THURSDAY, JANUARY 7

ROYAL INSTITUTION OF GREAT BRITAIN, at 3—Sir William Bragg. The Universe of Light (Christmas Lectures) (5).  
Light from the Sky.  
LINNEAN SOCIETY OF LONDON, at 5.  
INSTITUTION OF CIVIL ENGINEERS (Birmingham and District Association) (at Chamber of Commerce, Birmingham), at 6.  
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.  
INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 7.  
SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at Bristol University), at 7.30.  
ROYAL SOCIETY OF MEDICINE (Tropical Diseases and Parasitology Section), at 8.

## FRIDAY, JANUARY 8.

ROYAL GEOGRAPHICAL SOCIETY, at 3.30—Mrs Murray Chapman. Through Lapland in Winter with Sledge and Reindeer (Christmas Lecture for Young People).

ROYAL SOCIETY OF ARTS (Indian Section), at 4 30  
 ROYAL ASTRONOMICAL SOCIETY, at 5  
 ROYAL ANTHROPOLOGICAL INSTITUTE (Human Biology Research Committee), at 5 30  
 MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6  
 INSTITUTION OF MECHANICAL ENGINEERS, at 6—S B Freeman Modern Types of Propelling Machinery for Mercantile Marine Use (Thomas Lowe Gray Lecture)  
 INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7  
 ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 7  
 JUNIOR INSTITUTION OF ENGINEERS, at 7 30  
 GEOLOGISTS' ASSOCIATION (at University College), at 7 30  
 —Dr W F Whittard An Expedition to East Greenland, 1929 (Lecture)  
 SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (jointly with Institute of Chemistry) (at Newcastle-upon-Tyne)

#### SATURDAY, JANUARY 9

ROYAL INSTITUTION OF GREAT BRITAIN, at 3—Sir William Bragg The Universe of Light (Christmas Lectures) (6) Light from the Sun and the Stars

#### Public Lectures.

#### MONDAY, JANUARY 4

ROYAL GEOGRAPHICAL SOCIETY, at 3 30—The President South and East (Christmas Lecture for Young People)

#### WEDNESDAY, JANUARY 6

UNIVERSITY COLLEGE, at 3—Sir Richard Gregory, Bt Comets and Shooting Stars  
 IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5 30  
 —Dr T M Finlay The Evolution of Landscape (Swiney Lectures) (1) (Succeeding Lectures on Jan 8, 11, 13, 15, 18, 20, 22, 25, 27, 29, and Feb 1)  
 BELFAST MUSEUM AND ART GALLERY, at 8—Mrs H Richardson Costume and History

#### Conferences.

#### JANUARY 4 AND 5

MATHEMATICAL ASSOCIATION (at London Day Training College)

Monday, Jan 4, at 3 30—Sir Arthur Eddington The Decline of Determinism (Presidential Address)

At 5—Prof S Brodetsky Modern Dynamics in Astronomy, Relativity, and Quantum Theory

Tuesday, Jan 5, at 10 A M—Discussion on The Report of the Association of University Teachers on Entrance Tests and Initial Degrees

At 11 15 A M—Dr S Verblunsky The Foundations of Mathematics

At 12 15—Prof A Lodge Interpolation by Central Differences

At 2 30—G Frecheville The Application of Mathematical Methods to Research Work in Agricultural Economics

At 3 30—Discussion on Calculus and Co-ordinate Geometry at the School Certificate Stage, with special reference to the Additional Mathematics Syllabus of the Joint Matriculation Board of the Northern Universities

#### JANUARY 4 TO 11

CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College)

Monday, Jan 4, at 3—Sir William Rothenstein Presidential Address

At 5—Dr E Miller The Difficult Child Sociological v Individual Interpretations (Lecture) (British Psychological Society—Education Section)

Tuesday, Jan 5, at 2 30—Discussion on The Film as an

Instrument of Humane Education (University London Animal Welfare Society)

At 3—J H Whitehouse Public Schools and the Public Life (Lecture) (Society for Experiment and Research in Education)

Wednesday, Jan 6, at 3—Sir Richard Gregory, Bt Comets and Shooting Stars (Lecture) (School Natural Study Union)

At 5 30—Prof D Laurie Biology in Schools (Lecture) (Association of Assistant Mistresses)

Thursday, Jan 7, at 2 30—Mrs C B S Hodson The Feasibility of including Simple Biology and Heredity Teaching in the School Curricula (Lecture) (Eugenic Society)

Friday, Jan 8, at 2—Discussion of Physical Education in Schools (Medical Officers of Schools Association)

#### JANUARY 5 TO 7

EXHIBITION OF SCIENTIFIC INSTRUMENTS AND APPARATUS (at Imperial College of Science and Technology), 3 to 5 and 7 to 10

Tuesday, Jan 5, at 8—C C Paterson Photocells The Valves which operate by Light (Lecture)

Wednesday, Jan 6, at 8—T Smith Photographs Shutter and their Properties (Lecture)

Thursday, Jan 7, at 8—Sir Oliver Lodge Reminiscences (Lecture)

#### JANUARY 6 TO 11

GEOGRAPHICAL ASSOCIATION (at London School of Economics)

Wednesday, Jan 6, at 9 30 A M—Opening of Publishers' Exhibition and Address by Miss E H McLean

At 11 A M—Discussion between the Historical Association and the Geographical Association What is Historical Geography?

At 2—Sir Leslie Mackenzie A Health Administrator's Attitude to Geography (Presidential Address)

At 5 30—S A S Hozayen The Expansion of the Arabs and their Contribution to Geography (Lecture)

Thursday, Jan 7, at 11 A M—Mrs H Ormsby The Part played by the Limestones in the Human Geography of France (Lecture)

At 12—J Fairgrieve Demonstration Lesson with Films

At 2—Demonstration of Amateur Films

At 3—J Fairgrieve The Use of Films in Teaching

At 5—Prof P F Kendall How Britain became an Island (Lantern Lecture)

Friday, Jan 8, at 10 30 A M—Brigadier H S L Winter botham New Developments of the 1" Map (Lantern Lecture)

At 11 30 A M—Prof Gerhard Schott The Humboldt Current in Relation to Land and Sea Conditions on the Peruvian Coast (Lantern Lecture)

At 2 45—Discussion on The Difficulties of using the Lantern in Primary Schools

Discussion on The Scope and Content of the Geography of the 'rest of the world' in the First School Certificate Examination

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SATURDAY, JANUARY 9, 1932.

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## Science and Politics.

SOME months ago the British Science Guild committed itself to the important task of producing, on behalf of the scientific community, a volume which would assist the people of Great Britain, including its statesmen, politicians, administrators, financiers, and industrialists, to realise the value of the contributions which science has already made to our progress as a nation, and the potentialities of science in the evolution of a better order of society. This volume, when completed, will contain a survey of the results hitherto obtained by the application of science in all departments of national life: a survey of our existing industries and a comparison between them and the corresponding industries of certain other countries; a survey of the possible effects of the further application of science to our older basic industries and our newer industries, the possibility of creating new industries, and finally, how our industrial development is affected by legislative restrictions, our system of taxation, our banking and financial methods, the attitude of professional and manual workers' organisations towards the application of science, and political theory.

The compilation of such a work is a task to which those scientific workers who are conscious that they are also citizens must apply themselves, as much for the education of the scientific community as for the body politic. It cannot be denied that the scientific community has lost opportunity after opportunity since the War to take a more active part in the framing of national and imperial policy. The temptation leading its members into a narrow professionalism of outlook militates against their effectiveness in any sphere outside their own. They rightly charge others with the neglect of science, but the failure of the nation adequately to appreciate science and the scientific outlook is to some extent attributable to their own indifference to public opinion, to their own failure to make their work intelligible to the uninitiated, and to their scorn of, or at least indifference to, the efforts of some of their own fellow-workers to interpret their work to the lay community.

The pity is that this habit of mind is inculcated in most undergraduates studying science in our universities. Instead of being encouraged to regard a training in science as an indispensable qualification for the responsibilities of leadership in any field of national activity, they are led to believe that their studies in any particular branch of science unfit them for any occupations other than

those of teacher, research worker, or technologist in that branch. The consequence is that few graduates in science in Great Britain seek administrative or commercial posts with the large industrial and commercial corporations, take up posts with the banks, financial houses, or insurance companies, few apply for entry to the home or overseas administrative civil services—practically none find an outlet in the administrative services of local government bodies—they rarely turn their attention to the Bar or politics, or the diplomatic and consular services. In other words, although our civilisation is based on science, those trained in science leave to those who have not had this advantage most of the key positions in industry, finance, politics, and the various central and local government services of the Empire. May not this be the root cause of our present parlous economic position?

It will take time to remedy this state of affairs. Nevertheless, it must be remedied, and it is well that a start should be made now, when the nation is ready to listen to any authoritative diagnosis of its troubles and to give careful consideration to any suggested remedy or even palliative for them. It is dissatisfied with its statesmen, politicians, financiers, and industrialists. It has a religious faith in the efficacy of science. It is not impossible that the whole force of public opinion could be mobilised in support of a well-thought-out and comprehensive scheme, prepared by men of science, economists, and industrialists, for the effective utilisation of the resources of the British Empire. The first essential is that this scheme should be in the main the contribution of scientific workers with an interest in the economic and social implications of their work, and industrialists and others with a sincere belief in science and understanding of the scientific outlook. Another essential is that it should represent the collective views of the scientific community.

In his recent article on "National Needs" in *NATURE* of Dec. 26, "H. E. A." suggests that the Royal Society is the only body which can undertake this responsibility. We, however, do not hold this view. The Royal Society is not constituted to engage in the campaign required, or even to act as a focus. Having been consulted by the central Government for many years past, and being in receipt of Government grants, the Society is not in the position of independence essential for the consideration or criticism of public offices or affairs. Moreover, the fellowship of the Royal Society is not sufficiently catholic

to embrace many of those whose co-operation is essential for the production of a practical scheme for national and imperial reorganisation and reconstruction. Nevertheless, it is to be hoped that the Royal Society will be able to assist in this great task, whatever body undertakes it.

It is true that the British Science Guild by itself, because of the character of its membership, could produce a scheme which would command the attention of the country. But it is obvious that a scheme produced by and published with the authority of duly accredited representatives of all the various scientific and technical societies in Great Britain would carry more weight. The British Science Guild would welcome their co-operation, first, because it would show that the scientific societies had not lost all contact with the realities of modern life, and secondly, that they realised the need for a body to perform certain necessary and important tasks for which they lack both the funds and the machinery to undertake themselves individually. The industrialists have the Federation of British Industries as well as associations in each industry to safeguard their interests and, whenever circumstances demand, to express their collective views to Government and the general public. The same is true of the banks, financial houses, and trade unions. Industrialists, financiers, traders, and trade unions see to it that their interests are well represented in Parliament. Up to now, the scientific community has neither built up a strong representative body nor collectively assisted any of its members to enter the House of Commons, where the influence of ten or twelve members qualified to speak for science and backed by science would be disproportionately great in comparison with their numerical strength.

We suggest ten or twelve representatives of the scientific interest advisedly. One member cannot undertake the whole responsibility. On practically every subject of discussion in Parliament science has an important contribution to make, a point of view which should be expressed in the public way for which Parliament provides facilities, and which ministers of the Crown cannot ignore in the same way as they can ignore advice tendered through their departmental officials. Apart altogether from those matters which directly affect the scientific community, such as grants for research and for the training of research students, the efficiency of State scientific departments and the status of their expert staffs, patent law, the future of industrial research associations, where

the emphasis is on the duty of the general community to science, there is a wide range of subjects on which the emphasis is on the duty and service of science to the general community. These subjects include the effect of the maldistribution of gold and silver on our present trade and financial position, the question of the restriction of imports of manufactured goods and agricultural products, housing, health services, disarmament, imperial development (with which is linked the questions of emigration to the Dominions and the acclimatisation of whites in our tropical dependencies), the need for factory legislation in connexion with dangerous trades, and the development of our home resources, both industrial and agricultural.

When Parliament meets again in February, much of its time will be occupied in discussing the estimates of the various departments of State. Here, again, a critical survey by a group of representatives of science would be invaluable. That it will not be made is certain, first, because there is no such group in Parliament, and secondly, because the scientific societies have been slow to respond to the invitation of the British Science Guild to create a body competent to collect the necessary data as the basis of such activities.

### Ant-Lions and Worm-Lions

*Demons of the Dust: a Study in Insect Behaviour*

By Prof William Morton Wheeler Pp xviii + 378 (London Kegan Paul and Co, Ltd, n.d.) 21s net

A STUDY of parallel development in behaviour between the worm-lions and ant-lions must be interesting and important. "A legless maggot and a six-legged Neuropteran larva equipped with powerful sucking mandibles, carry on, though by somewhat different methods, one and the same industry for the purpose of obtaining their food." These are termed respectively the worm- and ant-lions. Their feeding is predatory, craters being made in loose sand, a larva lying partially hidden at the basal point of each. Ants and other small wanderers which stumble into these pits, slide in the sand and are at once grasped and sucked.

The ant-lion is a classical beast and is probably identical with the Myrmecoleon of Job, being referred to in the medieval commentaries thereon. Albert the Great (c. 1250) gave a description based on his own observations, and Poupert an adequate account in 1704. The anthropomorphism evidently attracted authors, for Vallisneri brings into a dialogue between Malpighi and Pliny in the

Netherworld (c. 1700) the habits of the larva and its transformation to the imago. The Abbé Pluche in his "Spectacle de la Nature" also adopts the same form and humanises the ant-lion as combining "the traits of an expert huntsman, an able geometrician and a miscreant with barbarous and bloody inclinations." This gave the ant-lion a reputation, which attracted the great personalities of zoology of the eighteenth century.

Réaumur's memoir was followed by Bonnet's, both founded on the living insects, the latter described how the larva pushes pebbles, many times its own weight, out of its funnel, placing the tip of its abdomen under them and backing. The pit is made by the larva marking a groove of the requisite diameter by moving backwards and tossing the sand from the inner border of the same to the outside by means of its head and closed jaws. The direction is clockwise or counter-clockwise. A cone is left in the centre, the process being continued within the circle, usually in the same direction, until the crater is completed. But even in the same species a direct method of digging has been observed, so that "the insect cannot be regarded as a pure reflex automaton, especially as a like variability also characterises all the remaining activities of its feeding cycle." The prey is automatically precipitated to the almost hidden larva, it is seized, smothered in sand, bitten and paralysed, partially digested by the injected saliva, and its juices imbibed, lastly, its carcass is thrown out, and the crater is repaired before the ant-lion resumes its quiescent wait for the next prey.

The Mediterranean worm-lion is the maggot of a fly and was known to Poupert, it formed the subject of the last of Réaumur's memoirs. This together with a report by De Geer on specimens sent by Réaumur to the Queen of Sweden are advantageously reprinted (translated) in appendices to the present volume. The further accounts of the worm-lions are mainly a product of the present century and are largely illuminated by our author's own observations on the animals, which he reared himself. Here, as throughout the book, the advance made is shown to be due partially to wider knowledge, especially of the fauna of the sands, and partially to improved technique, backed by the broader considerations of modern biology. Wheeler obtained his insects in the Balearic Islands and, feeding them mainly on white ants, transported them to Boston, where the last flies emerged about a year later. The pupal period extends through two or three weeks, the insect lying below the bottom of its burrow, in this stage it is sticky,

so that sand grains adhere firmly to it. Unfortunately, the emergent flies were delicate and would not mate, so that the eggs and first larval stage are still unknown.

A California subalpine species, the Sierra worm-lion, was described by Wheeler in 1918, but the reference is lacking. It occurs up to 9000 ft., at this height in quite unsheltered situations, whereas at 4000-5000 ft. in the Yosemite it is always in dust that is rarely wetted and little exposed to the sun's rays, the maggot evidently not being strongly thermotactic. Hundreds of larvæ were transported to Harvard and reared. Their pronounced annulation and marked mobility of the anterior segments form a useful comparison with similar features in many of the leeches. It would, however, be too technical to refer here to the excellent morphological descriptions given of this and of the other insects considered—especially, perhaps, that of the stomach and gut, the physiology of which is also of great interest. They lead to the general conclusion that the singular characters of this worm-lion “developed in specific adaptation to its own peculiar environment”, critical adjustment here is in the larval stage, whereas in the Hymenoptera this is best seen in the imago. The study of the behaviour and development of the larvæ in Wheeler's laboratory and the deductions therefrom form a delightfully interesting chapter, of high scientific value and of literary excellence.

While the above species of worm-lions and two others from the western States and Cuba belong to *Vermileo*, another allied genus, *Lampromyia*, is found in Africa. One species was collected by Wheeler in the Canary Islands, being transported as usual to his laboratory, fed, observed, and reared. Later, he was sent live specimens from Sarawak of yet a third genus, which he terms the “worm-tiger”.

The concluding chapter summarises the whole question of the astonishing conformity of behaviour between the larvæ of the ant-lion and of the worm-lion, the differences to us appearing much less striking, though fully emphasised in the text. The behaviour pattern of either insect is so complicated that its evolution could only have been built up very gradually. This appears likely, the ant-lions being partially traced back to Permian and the worm-lions to Jurassic forms. The present distribution of both and other considerations lead to the suggestion that they developed their larval behaviour in some semi-arid Mesozoic period. The term ‘lochesis’ is suggested for the ambushing of prey by many organisms instead of actively seeking it. We certainly would not apply this term to

plants, and would hesitate to do so to most marine animals other than Antennulata, especially sedentary colonial forms. The discussion which follows is illuminating, as emphasising the rôle of the environment in the behaviour of animals. The insect here makes a portion of its surroundings into a collecting crater, while many animals use flowers and other objects as traps, in the case of web-formers, we find ‘exteriorised’ portions of an animal's own body employed to the same end.

As compared with Wheeler's previous works, we may say of this book, as he himself remarks of Réaumur, that it “reveals no impairment of his unusual powers of observation”. Indeed, it shows development, mature literary form, and such a nice biological delight in his pets that he interests his readers in every phase of his subject. A book like this does much to break down the arbitrary and most undesirable separation of ‘entomology’ from ‘zoology’, we hold that the greatest curse from which zoology suffers is the dividing off from it of many ‘ologies’, which, it is imagined, can be pursued by professional scientific men without an understanding of basal facts relating to living matter.

J STANLEY GARDINER

#### Organic Chemistry. General and Specialised.

- (1) *The Principles of Organic Chemistry* By Prof. James F. Norris (International Chemical Series) Third edition Pp. xii + 595 (New York McGraw-Hill Book Co., Inc., London: McGraw-Hill Publishing Co., Ltd., 1931) 15s. net.
- (2) *Theoretische Grundlagen der organischen Chemie.* Von Prof. Walter Huckel. Band 1 Pp. xi + 410. 24 gold marks. Band 2 Pp. iv + 352. 20 gold marks. (Leipzig Akademische Verlagsgesellschaft m. b. H., 1931.)
- (3) *Die Polysaccharide* Von Hans Pringsheim. Dritte vollständig veränderte Auflage Pp. ix + 393 (Berlin Julius Springer, 1931) 26.80 gold marks.
- (4) *Die Alkaloide eine Monographie der natürlichen Basen* Von Winterstein. Zweite neue bearbeitete Auflage von Dr. Georg Trier. Teil 2 Pp. xi + 357-1061 (Berlin Gebrüder Borntraeger, 1931) 42 gold marks.

(1) **P**ROF J. F. NORRIS is well known to organic chemists as an original investigator and a teacher of wide experience. His mode of introduction to the fundamental principles of the science is unusual, but deserving of consideration by other

teachers of the subject. Probably many teachers would prefer an arrangement different from that adopted, and, indeed, Prof Norris's arrangement involves at times a considerable amount of reference to different parts of the book in connexion with the treatment of particular classes of compounds or individual substances. Few other authors of such a textbook have indicated more clearly the wide ambit of organic chemistry and its bearing on our knowledge of biological processes, and although the book may be regarded as somewhat encyclopædic for beginners, the perspective between different branches is well maintained.

It is unusual for such a textbook to be lacking in illustrations and to contain so few references by name to outstanding investigators. The absence of illustrations renders some descriptions rather lengthy and somewhat vague, and although the name of an investigator means little when the personality is obscured, it may be a convenient 'peg' on which to hang facts or principles. A unique feature of the book is the chapter devoted to the identification of organic compounds and the determination of their structure. This is extremely well done and is valuable for systematising the reader's knowledge. The book is attractively written, and has so many things to recommend it that it is almost a shock to find that the nomenclature used for the simple monosaccharides is not more systematic.

(2) Prof W Huckel's "Theoretical Principles" is deserving of the closest study as a statement by an authority who has carefully considered the present conceptions and their development both as regards structure and the mechanism of reaction of organic compounds. The treatment of some parts of the subject is highly condensed, but the author has kept his treatise within reasonable dimensions without omitting the discussion of any modern method for investigating the structure and behaviour of organic substances.

A comprehensive criticism of the author's opinions would involve far more space than can be available in an ordinary review. It is certain that these will be criticised, but this criticism will serve to stimulate further investigation on organic compounds by methods which have been made available in recent years. Already, Huckel's views are being quoted in original communications, and the author is to be congratulated on the production of a comprehensive work of outstanding value to present-day organic chemistry.

(3) During the last seven years the developments in carbohydrate chemistry have been fundamentally

important, primarily as a result of W N Haworth's investigations of the simple sugars, and the third edition of Prof Pringsheim's monograph is a useful résumé of our present knowledge of the more complex portion of this section of organic chemistry. The book is well printed and the formulæ particularly well set out.

The simple polysaccharides from the maltose type to the tetrasaccharides are discussed for the most part in tabular form in the first section of the book, the remainder being devoted to the complex polysaccharides, cellulose, starches, etc. It might be pointed out that the references to the literature on the constitution of the simple polysaccharides in the tabular list are not complete in themselves, but are supplemented by others appearing later in the same section of the book. This indicates that the book requires detailed study, otherwise it might appear that important references had been omitted. A little fuller critical treatment in this section would have been advantageous.

The second section contains an exhaustive treatment of cellulose, starches, and inulin with regard to the properties of their different forms and their bacterial and fermentative decomposition, and, after discussing modern methods for the determination of the constitution of these highly complex substances, present views regarding the actual constitutions are particularly well stated. Although the book is somewhat expensive—a not unusual feature of modern German works on chemistry—it is a most useful contribution to the literature of the subject.

(4) All workers in alkaloid chemistry must be familiar with Dr Trier's comprehensive and excellent monograph generally known as Winterstein and Trier's "Die Alkaloide". The special portion of this second part contains a well-written account of the history, the determination of the chemical constitution, the biochemistry, pharmacology, toxicology, the therapeutic uses, etc., of the lupin and lobelia alkaloids and those of the indole, quinoline, and isoquinoline groups which include the alkaloids of the strychnine, morphine, papaverine, and cryptopine groups. The author's connotation of the term 'alkaloid' has made it possible for him to include an account of the two interesting bacterial colouring matters, pyocyanin and prodigiosin, together with the ptomaines, vitamins, and hormones. In view of the rapid growth of our knowledge of the vitamins and hormones in consequence of the work of so many investigators at the present time, this section will become out of date very rapidly.

The general portion deals with such general problems as the relationship between constitution and sources of the alkaloids, the relationship between pharmacological action and chemical constitution, the methods of analysis and outlines of methods of determination of the constitution of the alkaloids. The value of the book depends not only on the detailed information it contains, but also on the many indications as to materials which need further investigation both by the chemist and the pharmacologist

C S GIBSON

### The Philosophy of Science.

*Du cheminement de la pensée* Par Émile Meyerson  
(Bibliothèque de philosophie contemporaine)  
Tome 1 Pp xxvii+294 Tome 2 Pp 295-716  
Tome 3 Pp 717-1036 (Paris Félix Alcan, 1931) 130 francs

THE last work of M. Émile Meyerson is a noble completion of those which have preceded it. It is marked by the same thoroughness and impartiality in examining the views of others, the same steadiness in presenting his own, the same confidence in the progress of science and the growing unity of thought. Coming last, and being written with due care and leisure, it contains a full review of the philosophical bearing of relativity and the quantum theory, as well as a recapitulation of the argument of the earlier books. The third volume of this work, which consists entirely of extracts from the writers whom he quotes from all ages, is alone well worth the trouble of publication, and the whole three volumes, sold at little more than £1 (gold currency!), are indispensable for anyone interested in the nature and history of scientific thinking. The excellent French, the invariable politeness, the flashes of humour, make the book as delightful as it is enlightening.

The general thesis remains the same as that developed in "L'explication dans la Science" and "Identité et Réalité". The author sums it himself in a phrase which deserves to live: "L'Homme sait le divers et veut l'identique". This essential process of seeking constantly fresh identifications in a real which presses upon us in growing richness and variety, is traced from the Greeks to the present time.

The book is so convincing that it is worth while to examine in some detail the reasons why it leaves this impression on the mind. The main reason is that M. Meyerson never allows himself to take absolutely one side in any of the sharp oppositions

of thought which have marked the 'cheminement de la pensée' throughout the ages. He is frankly a dualist, and shows how at every stage of thought a fresh combination of the real of experience is offered to the inquiring mind of man, and at each stage the mind adds something to it from its own creating and synthesising power. Thus, even in the simplest form of identification, Kant's numerical 'equation',  $5+7=12$ , something is added, the result is not a pure tautology. So, with an algebraical identity,  $(a+b)(a-b)=a^2-b^2$ , there is much more than mere identity.

Something new is gained from every experience. The case is even clearer in the origins of geometry. Meyerson has no doubts, and leaves none in our minds, that the foundation of this science is the work of the creative genius of the Greeks, and he goes on to show that the Aristotelian syllogism, unjustly condemned as tautological by a dominant modern school, conforms also to his ideal of actually enlarging our thought in the guise of expressing another identity. Thought never advances either by pure extension or pure analysis. At each step we take in some new fact and then proceed to see its essential connexion with an identity which we have previously established. No general idea, whether in mathematics or in non-mathematical thinking, is purely a collection of objects or of notions 'externally brought together'. In every case we imply, or seek for, some coherence of the attributes in the essence or nature of the genus or general idea.

This is the act of identification which M. Meyerson finds to be common to all forms of scientific thinking. All thought is movement and all phenomena are change. What M. Meyerson means by 'identity' is really the result of the constant effort of the mind to seize the common element in the passing show. The difference between mathematical and other kinds of reasoning is not in essence but in the fact that in mathematics the identification is more precise.

The other fundamental aspect of the subject is the fact that there must be identity between diverse minds before any general judgment can be passed on the diverse real. *Nolenti non fit demonstratio*. On this side again we may go back to Aristotle, who declared that both in the syllogism and other forms of reasoning there must be assent as well as formal demonstration. M. Meyerson's attitude throughout is the best possible for inducing this frame of mind in others. He always seeks first for what he can accept in the views of those whom he criticises. He scarcely



mentions anyone from whom we may not gain some enlightenment, and the total effect of this method of approach in the gradual unfolding of the human spirit in the history of science is most inspiring. He rightly regrets the limited interest taken in this supreme subject, and the highest recommendation of the book is that it is bound to send some of its readers to study the material on which it is based.

Apart from this, it contains the most admirable and convincing criticism—convincing because so temperate as well as searching—of Bergson, Bradley, Brunschwig, and many other workers in the field.

F S MARVIN

### Short Reviews.

*A History of Geographical Discovery and Exploration*. By J N L Baker (Harrap's New Geographical Series). Pp 544 (London, Bombay and Sydney: George G Harrap and Co, Ltd, 1931). 12s 6d net.

MR. BAKER'S pioneer effort to survey the whole field of geographical discovery throughout the centuries fills a long-felt need. There is an embarrassing wealth of original accounts of voyages of discovery, and there are a few outstanding studies of particular periods or regions. With remarkable skill and accuracy the author has here gathered together all the essentials of our knowledge of the obtaining of the data on which modern charts and maps are based. A short bibliographical study precedes the volume, for each chapter a main source list is given and, in addition, there are numerous text references to authorities. The author frequently points out that the more spectacular voyages were by no means always the most fruitful in scientific results, his thoughtful appraisal of the ultimate geographical importance of many little-known voyages should help to stimulate the student's critical faculty.

There are fifty line maps, some of them arranged on a folder method which makes it easy to consult them when reading other pages. The frontispiece shows the world according to Behaim (1492) superimposed upon a map of the world as known to-day.

In a brief summary the author directs attention to an important, but too often forgotten, fact—the very small proportion of the world which has been scientifically surveyed in detail. Students need to be reminded that the printed map frequently gives a deceptive suggestion that all is known of a region. S. Obruchev's work in north-east Siberia (1926) shows how misleading are all available maps of that region. A further edition of this volume will inevitably be called for, since it is indispensable for all serious students of geography, in it we hope there may be added a map indicating the extent of fully surveyed country. The publishers have done geography a service by issuing so full and detailed a book at such a reasonable price.

*The Sturge Collection: an Illustrated Selection of Plants from Britain bequeathed in 1919 by William Allen Sturge*. By Reginald A. Smith. Pp xii + 136 + 12 plates (London: British Museum, 1931). 25s net.

IN 1919 the archaeological collections of the British Museum were much enriched by the bequest of the large and valuable collections of the late Dr. Allen Sturge. He had amassed specimens on his visits to England from Nice, where he was in practice, and on his retirement, when he settled at Icklingham in Suffolk, he became an assiduous collector, with the assistance of his wife, in that happy hunting ground of the student of the stone age implement. To his own collections he added others by purchase from time to time, those belonging to Canon Greenwell, Allen Brown, and Worthington Smith, among others, passing into his possession. Nor was his interest confined solely to the specimens from Britain, which are dealt with in the work under notice. The implements from other parts of the world which he collected have gone to the Ethnographical Department of the British Museum.

In this descriptive catalogue of a selection from the British implements now in the Department of British and Mediæval Antiquities, geographical distribution has been followed in preference to typology, in accordance with the arrangement for exhibition purposes. Dr. Sturge's home at Icklingham has been taken as the centre, and the various sites are grouped according to their distance from it. The list is very fully illustrated, so that in addition to being a tribute to the testator's generosity, which is its primary purpose, it is also an album which, while indicating the richness of the bequest, may also serve, as its author hopes, to fix types and nomenclature for the benefit of the student. There is no discussion, but ample references are made to the relevant literature.

*Spencer's Last Journey: being the Journal of an Expedition to Tierra del Fuego by the late Sir Baldwin Spencer, with a Memoir*. Edited by R. R. Marett and T. K. Penniman. With Contributions by Sir James Frazer and H. Balfour. Pp xii + 153 + 14 plates (Oxford: Clarendon Press, London: Oxford University Press, 1931). 12s 6d net.

A SENSE of tragedy is inseparable from this volume commemorating Baldwin Spencer's last journey, the expedition to Tierra del Fuego in 1929, on which he died. Although he himself would, no doubt, have chosen to end his life in harness, his work was unfinished. His intercourse with the few Yahgans with whom he came into touch was not without result. He collected implements, which are described by Mr. Balfour in an appendix, and he recorded some of their kinship terms and a small vocabulary which will be of service to science, but anthropologists must forgo the light of his unrivalled first-hand knowledge on the problem which has been raised by the suggested affinities between Fuegian and Australian culture.

Baldwin Spencer's journal, which is here printed in full, and his note-books exemplify the care with

which he worked. They show, too, the skilfully exercised powers of observation of Nature which always lay behind his work, and were unimpaired with the passing of years. Sir James Frazer's eloquent appreciation of Baldwin Spencer's work, which places it in true perspective as a unique record of which time will enhance the value, Dr Marett's sympathetic memoir, and Miss Jean Hamilton's account of the last few days before his death and her perilous journey in conveying his body to its last resting-place, make this a volume which all admirers of Spencer's work will treasure.

*Nucleic Acids*. By P. A. Levene and Lawrence W. Bass. (American Chemical Society Monograph Series, No. 56.) Pp. 337. (New York: The Chemical Catalog Co., Inc., 1931.) 4.50 dollars.

SPECIALIST knowledge grows apace, though sometimes at great difficulty, along the paths of error and controversy, by the combined labours of many workers. This is particularly true of the chemistry of the nucleic acids, about which there are already two monographs by English and German authors, now supplemented by one from an American writer whose own researches in the field have been of prime importance. The plan adopted by Drs. Levene and Bass is to deal first with the components of the nucleic acids, then with the nucleosides and nucleotides, and finally with the nucleic acids and the enzymes which decompose them. In part the subject is treated in historical sequence; there are ample references and two indexes.

The nucleic acids are established in structure as phosphoric esters of glucosides, the organic radical being a pyrimidine or purine derivative. By their very structure such complex compounds are liable to reversible intramolecular rearrangements which it is fair to assume will alter both their chemical and biological function.

Chemists are beginning to gain an idea of the importance of phosphorus compounds in the living cell, especially as factors in facilitating molecular rearrangements and transformations as witnessed by their function in fermentation and in muscular changes. It is probable that we are on the eve of striking advances in our interpretation of intracellular reactions, and it is essential that the whole existing knowledge of the subject should be adequately presented in monograph form, as is done here.

*Plane Trigonometry*. By B. B. Bagı. Pp. vii + 248. (Dharwar: The Author, Reddy Housing Society, 1931.) n.p.

THIS volume has been written essentially to suit conditions in Indian colleges. The author claims that his treatment has greater vigour and comprehensiveness than is to be found in many of the existing textbooks written for use in English schools. It is a little difficult to see precisely wherein the real divergence lies, for the book begins, as usual, with the measurement of angles, the use of signs in geometry and orthogonal projection. It then covers the customary groundwork up to the properties of triangles and quadrilaterals. There are

also short chapters on finite series and products, elimination and limits. It seems strange to divorce elimination from equations, yet the latter comes roughly in the middle of the book, whilst the former is relegated to Chap. xx—the last but one!

The relations between the sides and angles of a triangle are established by a uniform method founded upon projection, whilst in solving triangles the older method of using tabular logarithms is used to avoid the negative characteristic. Seven-figure tables with the necessary work in proportional parts are employed, and on p. 126 a reproduction of a page from Chambers's "Tables" is given.

There are many examples taken from recent examination papers fully worked out to illustrate the text, and each chapter ends with a good selection for the student to solve.

*Il passato e il presente delle principali teorie geometriche, storia e bibliografia*. Per Prof. Gino Loria. Quarta edizione totalmente rifatta. Pp. xxii + 467. (Padova: Casa Editrice Dott. Antonio Milani, 1931.) 60 lire.

THE first edition of Prof. Loria's treatise on the history and bibliography of geometry was an expansion of a course of lectures delivered at Genoa in 1886. After an introductory chapter on geometry up to 1850, there followed eleven more dealing respectively with higher plane curves, surfaces, space curves, differential geometry, analysis situs, line geometry, correspondences and transformations, enumerative geometry, non-Euclidean geometry, hyperspace, and miscellaneous topics. This was translated into German and Polish. The second edition added references up to 1896. The fourth edition is doubled in size, the extra matter forming a second part, on a similar plan to the first, but dealing with contributions since 1896. It is remarkable that so much good work has been done in this period, which includes the War years. The book will be a most valuable aid to geometrical research. H. T. H. P.

*Storia delle matematiche*. Per Prof. Gino Loria. Vol. 2. *I secoli XVI e XVII*. Pp. 595. (Torino: Società Tipografico-Editrice Nazionale, 1931.) 25 lire.

THIS admirable work continues the history of mathematics into the sixteenth and seventeenth centuries. This period, which includes such great names as Tartaglia, Napier, Descartes, Galileo, Fermat, Leibniz, and Newton, to cite only a few, presents to the historian a difficult task of discrimination. Prof. Loria has approached the subject on the lines laid down by Montucla: "L'histoire d'une science n'est pas celle de tous les auteurs qui en ont écrit, mais seulement de ceux qui ont contribué par leur travaux à en reculer les bornes." Nevertheless, he has chosen the matter with such care that very little which is of historical importance seems to have escaped the net. Each chapter is accompanied by a very full bibliography which permits a more detailed study of any particular point on which further information may be required.

## Metallurgical Researches of Michael Faraday.

PRIOR to 1819, when Faraday published a paper on the composition of Indian Wootz steel, his contributions to knowledge had been represented by comparatively short communications, with no very obvious connexion. His first research of any magnitude was, therefore, the one on the alloys of steel with other metals, on which he was engaged for the next five years. This work, carried out in collaboration with a Mr. James Stodart, a manufacturer of cutlery and surgical instruments, led to the publication of two further papers in 1820 and 1822. Of these, the former is an account of small scale experiments made in the laboratory of the Royal Institution, and the latter, on ingots, 10 lb.-20 lb. in weight, melted in Sheffield. The cause of this interest in steel cannot now with certainty be determined, but Faraday's association with Stodart, and a decision of the Board of Management of the Royal Institution of 1812 that it was desirable that experiments should be undertaken on the alloys of metals, may both have played important parts.

That Stodart's influence was probably considerable is indicated both by the subject of Faraday's first metallurgical contribution and by the fact that after Stodart's death, in 1823, no further paper on this subject appeared. Faraday's diary contains but three further references to steel, the last of which is dated June 28, 1824. That Stodart was much impressed by the Wootz steel is shown by his trade card, preserved in the British Museum, which reads: "J. Stodart, at 401, Strand, London, Surgeons Instruments, Razors and other Cutlery made from Wootz, a steel from India, preferred by Mr. Stodart to the best steel in Europe after years of comparative trial". The desire to imitate this steel for surgical and other cutlery was clearly one of the main objects of Faraday's research, the other to prepare an alloy suitable for mirrors which would not corrode.

Before discussing the results to which this work led, it is not without interest to attempt to discover why it came to such a sudden and untimely end. For this, Stodart's death must in some measure be held responsible; for after giving Faraday every credit for his (in all probability very large) share in the work, the practical experience and keen interest of his collaborator must have exercised a considerable influence. This, probably, with a growing enthusiasm for other lines of research, and a feeling of disappointment with the results obtained from his work on steel, evidently caused his interest to wane. The opinions of his scientific contemporaries are well indicated by the following extract from the obituary notice to Faraday in the *Proceedings of the Royal Society*: "The results of the paper on steel by Stodart and Faraday to the Royal Society in 1822, were of no practical value, and this, one of his first and most laborious investigations, is strikingly distinguished from all his other works by ending in nothing".

That the research was laborious is well shown by one of Faraday's own letters, in which he says:

"Pray, pity us that, after two years' experiments, we have got no further; but I am sure, if you knew the labour of the experiments, you would applaud us for our perseverance at least".

What, then, were the fruits, if any, of this five years of continued research? It is to Faraday's credit that, for the first time, a series of steels were examined with sixteen different metallic additions and of varying concentrations. Secondly, he determined, in all probability as accurately as has been done even to the present day, the solid solubility, which he gives as 0.2 per cent, of silver in steel. This was, the writer believes, the first time that such a determination had ever been made. He further showed that both platinum and rhodium dissolve in steel in all proportions; for the former metal this was confirmed in 1907, whilst for the latter it still remains the only research ever carried out.

Faraday prepared the first of the 'stainless steels'. That the alloy contained 50 per cent of platinum, and hence found no useful application, does not detract from a scientific discovery of first-rate importance. Next, by treatment of a steel with acid, he prepared from it a "soft, grey, plumbaginous powder" which, he says, "appears to be a carburet of iron". Priestley, it is believed, had done this at an even earlier date, but Faraday's rediscovery of iron carbide in steel appears to have been entirely independent. By heating a polished surface of his chromium steel, Faraday developed its structure; the very first use of the process now known as 'heat-tinting'. In considering the effect of titanium on steel, he came to the conclusion, which is most generally accepted to-day, that this element does exert a distinctly beneficial effect, but that it finds no permanent place in the steel to which it is added. Considering his experiments on the rusting of the special steels, he points out that nickel reduces the tendency to corrode, and that, other things being equal, a high carbon steel rusts more rapidly than does one of lower carbon content. Finally, he observes that his rhodium steel is more resistant to softening by tempering than a plain carbon alloy is, a conclusion which, if followed up, might well have led to the production of steels of the high-speed type long before they were actually devised.

This, then, is part of the fruit of a research which "ended in nothing". If, however, both Faraday and his scientific contemporaries failed to realise the importance of the results which had been obtained, and to build upon the foundations which he had laid, there are clear indications that a certain section of the producers of steel were greatly impressed. The one steel which Faraday picks out from all he produced was that containing a small percentage of silver. In his own words, "its alloy with steel is the most valuable of those which we have made. To enumerate its applications would be to name almost every edge-tool. It is also probable that it will prove valuable for making dies,



especially with the best Indian steel." In the later paper, dealing with the large scale experiments, he again says that it "was harder than the best cast steel or even than the Indian Wootz, with no disposition whatever to crack either under the hammer or in hardening—its application will probably be extended not only to the manufacture of cutlery, but also to various descriptions of tools; the trifling addition of price cannot operate against its very general introduction. The silver alloy may

result of Faraday's work, and provide some indication of the esteem in which it was held by the actual steel-makers.

What has become of the ingots cast in Sheffield will in all probability never be known, but of the steels prepared in the Royal Institution we have now a most interesting and detailed knowledge. A wooden box labelled 'Faraday' and 'Steel and Alloys', the former probably, and the latter almost certainly, in his own writing, has recently

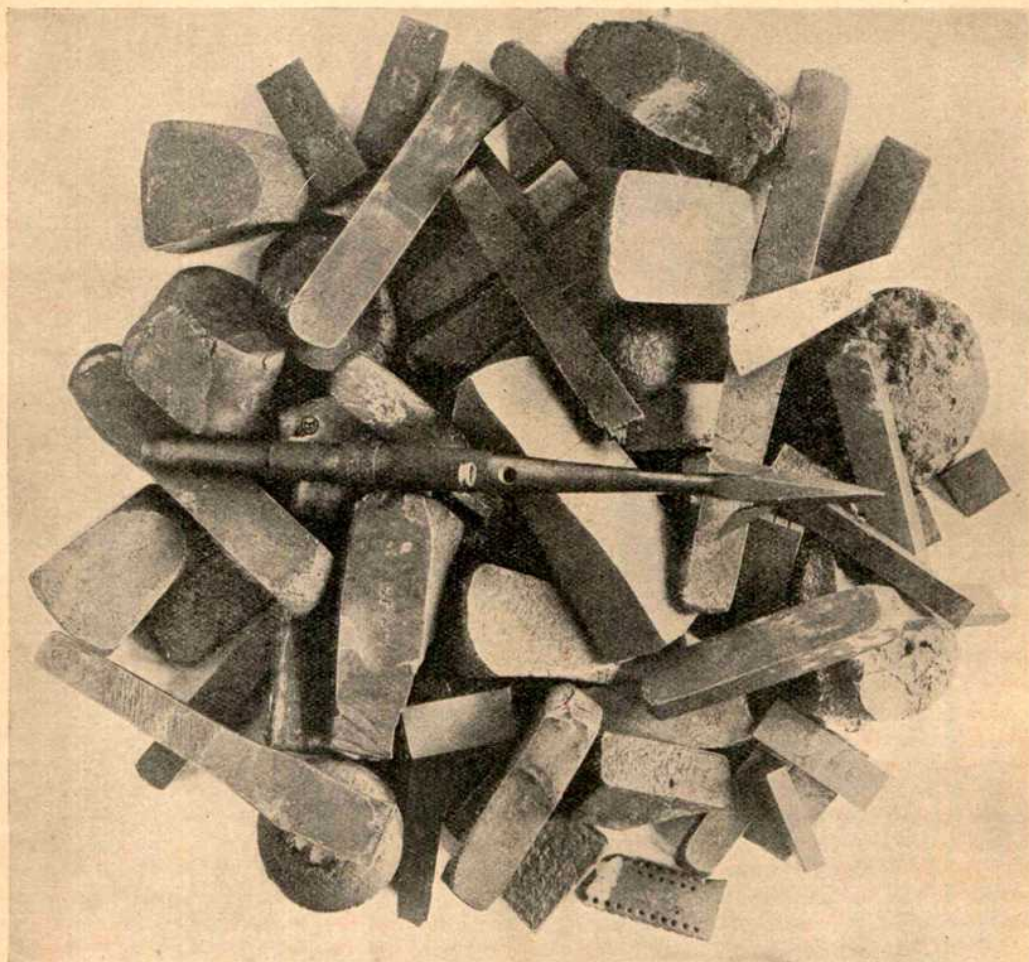


FIG. 1.—The seventy-nine steel specimens taken from Faraday's box. Reproduced by courtesy of the Royal Society from *Phil. Trans.*, A, vol. 230.

be advantageously used for almost every purpose for which good steel is required."

Even to-day there is on the market the so-called 'silver-steel', which, in general, is quite free from that metal, the name referring merely to a high-class, high-carbon crucible alloy. The writer well remembers a visit to a crucible steel works in Sheffield some twenty-five years ago, and seeing the head-melter, with much ostentation, dropping a sixpenny piece into the 'pot' containing some sixty pounds of liquid steel, which addition he was assured would confer on the metal superlative qualities. There can be very little doubt that both the name and the practice are the direct

come to light. This contained seventy-nine specimens, which were handed over to Sir Robert Hadfield for investigation. An account by him of an examination of these, which historically is of the very first importance, has now been published (*Phil. Trans.*, A, vol. 230, p. 221, and *British Assoc.*, Sept. 24, 1931). The scrupulous care taken of this unique material is indicated by the fact that although about 430 separate chemical estimations have been made, with 210 other determinations of structure, hardness, specific gravity, resistance to corrosion, magnetic and electrical characteristics, etc., more than 6½ lb. of the steel still remains, from an original weight of less than 8 lb., representing more than

seventy-five per cent of the total. The samples themselves are shown in Fig. 1.

Broadly, the samples fall into the following categories. In group *A* are three 'buttons', evidently the original melts as they solidified from the furnace. These, like the samples in group *B*, weigh at most 4.5 oz., the latter section, however, consisting of roughly hammered 'blooms'. In group *C* these small 'blooms' have been further hammered into bars. One such bar, however, is far more regularly fashioned, and from its analysis Sir Robert Hadfield draws the perfectly logical deduction that it may well have formed a portion of the steel which Faraday used as the raw material for some of his melts. The other type of basis metal appears to have been an English wrought iron of low carbon and considerable purity for a material of such origin. That a low carbon base must have been employed for some of the melts is shown by the fact that among the samples which have already been analysed is one which contains only 0.07 per cent of carbon and 2.25 per cent of platinum. Some idea of the quality of this achievement, bearing in mind the primitive apparatus available, will, perhaps, be better appreciated if it is pointed out that when, some seventy years later in 1894, Arnold carried out his classical research on "The Influence of Elements on Iron"

with an equipment vastly more complete and satisfactory than anything which Faraday had at his disposal, in three cases only out of ten was a smaller amount of carbon present in the alloy than in this remarkable material which Faraday turned out in his simple 'blast-furnace'.

The importance of the production of an untarnishable steel for mirrors in this research is shown by a whole group of other samples with one or more highly polished surfaces. Among the samples from the Royal Institution, the high platinum-metal alloys were not represented. The steel noted by Faraday which, as a result of the large proportion of platinum it contained, did not corrode, was not, therefore, examined. Quite recently, however, a further series of samples, the property of Mr. A. Evelyn Barnard, has been discovered by Sir Henry Lyons. These also have been placed at Sir Robert Hadfield's disposal for examination, and in a preliminary note in the paper read before Section G (Engineering) of the British Association, high platinum, rhodium, and palladium steels, of such a composition that they can only represent Faraday's alloys, have been found. To all interested in metallurgy, in Faraday himself, and in the history of scientific discovery, the investigation of these alloys will be a matter of the greatest interest. F. C. T.

### Xeromorphic Adaptations of Plants.

THE leaves of plants which are found growing in dry situations often show certain structural characteristics in common—thick-walled tissues, thick cuticles, stomata sunken below the surface, etc. These structural features seemed likely to cut down the loss of water from the leaf, and therefore, with little experimental investigation, they have been classed as adaptational mechanisms against water loss and spoken of as 'xeromorphic'. Of recent years the experiments have been carried out which should properly have preceded the adoption of any such interpretation of these characteristic structures.

The result has been considerable misgiving as to the soundness of a view that had long held its place in the elementary textbooks and a great recrudescence of interest in the problem, as is well illustrated by the symposium on xeromorphy at the International Botanical Congress at Cambridge in 1930. Papers by Maximow, Huber, Schratz, and Thoday, which were read at this symposium, have now appeared,<sup>1</sup> whilst an interesting résumé of some aspects of the subject has been published by E. G. Pringsheim.<sup>2</sup>

It is by no means easy to obtain good comparative figures of evaporation rates from different leafy shoots. It is dangerous to assume that twigs removed from the plant will give values indicative of the behaviour of the same shoots upon the tree, and Schratz points out also that the comparative rates of evaporation determined for different severed shoots will vary with the duration of time employed in making the observation.

Results with the shoots still growing upon the

plant would therefore appear more valuable, but the difficulty now lies in finding a practicable method for determining the comparable rates of water loss, whilst at the same time it is clear that the structural features of the shoot tissues immediately in question, are only one amongst many variables determining the evaporation from the plant. Seybold's method<sup>3</sup> of treating the evaporating surface as a wet bulb hygrometer seems a step in the right direction and is applicable with the growing plant, but, as Maximow points out, the real temperature of the transpiring surface is still in doubt.

In view of the experimental difficulties, it is not surprising that there is still considerable difference of opinion as to the significance of xeromorphic structures, but a certain general measure of agreement seems to emerge when these recent papers are examined. Thus it seems to be generally agreed that xeromorphic leaves have about the same proportion of stomata to epidermal cells as less xeromorphic leaves of the same species. As the cells of the xeromorphic leaf are usually smaller, this means that the xeromorphic leaf has a larger number of stomata per unit surface, so that it is not surprising to find that, when the stomata are open and the leaves freely supplied with water, xeromorphic leaves lose water more rapidly than less xeromorphic leaves of the same plant. The point is made very clearly by Huber in his comparison of 'sun' and 'shade' leaves, where the sun leaves, borne near the top of the leafy crown of the tree, are xeromorphic as compared with the shade leaves of the lower branches. Such



sun leaves under equal experimental conditions, upon detached shoots given a liberal water supply, evaporate relatively more water than the shade leaves

On the other hand, under conditions of water deficit, such as will occur more frequently to 'sun' leaves or plants of dry habitats, whilst the adjustment of stomatal aperture is usually more sluggish in such leaves—so that the shade leaves and the plants of normal, mesophytic habitats restrict their water loss more rapidly with diminishing water supply—when once the stomata are closed the loss of water from the xeromorphic leaves is much slower and they do not dry out and wilt like the mesomorphic leaves. Maximow emphasises the fact that they recover more readily after such exposure to drought, and regards this as perhaps the outstanding factor in their resistance to drought,<sup>3</sup> but most contributors to the recent discussions on this subject could agree with his recasting of Schimper's original definition to read that "xerophytes are plants of dry habitats which are able to decrease the transpiration rate to a minimum when under conditions of water deficiency"

From the new point of view, many of the structural features of these xerophytes may come to be regarded rather as natural consequences of growth in a dry habitat than as direct biological adaptations to minimise water loss. Thicker cuticles and thicker walls may be natural results of growth under conditions which repeatedly favour excessive water loss—and therefore processes of deposition

from solution and of chemical condensation—during the growing period

Pringsheim's paper, as also an interesting footnote to Thoday's paper, suggests that a re-examination of 'water-storage' tissues will also become necessary as the water relations of the cell are better understood. The work of Ursprung and Blum has created the impression that volume changes of the cell are mainly governed by the elastic properties of the cellulose wall, but most of the increase in cell volume during growth is irreversible, and Oppenheimer has recently criticised very effectively<sup>4</sup> the experimental basis of this work. He has shown that reversible alterations in volume of about twenty per cent may be seen in thin-walled cells but not in typical thick-walled cells. On the other hand, as Pringsheim points out, the wall may follow alterations in volume of the cell, due directly or indirectly to water loss upon evaporation, although not a stretched elastic membrane. Upon the possibility of such volume changes, in which cell size and shape and tissue configuration will play an important rôle, will largely depend the availability of the water in the cell to supply the needs of other tissues. Thus a large-celled, thick-walled parenchyma may lose water to a thin-walled small-celled meristematic tissue in which volume changes are less easily induced as the result of water loss

<sup>1</sup> *Journal of Ecology*, vol. 19, Aug. 1931

<sup>2</sup> *Die Naturwissenschaften*, Aug. 14, 1931

<sup>3</sup> "Die physikalische Komponente der pflanzlichen Transpiration", 1929. See *NATURE*, 124, 293, Aug. 24, 1929

<sup>4</sup> *Ber. Deutsch. Bot. Ges.*, 48, 130-140, 1930

### Problems of Filterable Viruses.

THE frequency in recent years of viruses and virus diseases as subjects for discussion at international congresses testifies alike to the wide interest manifested in the biological problems that await solution and to the far-reaching economic importance of this type of infection in the animal and plant worlds. In *NATURE* of Oct. 10 appeared the main part of Dr. H. H. Dale's presidential address to Section I of the British Association. This address dealt strictly with the biological nature of viruses, an aspect of the general virus problem which, in spite of intensive research in many countries, is likely to offer for some considerable time yet abundant scope for speculation. Dr. Dale's careful analysis of the available information led him, on the whole, to favour as the best working hypothesis one which postulates that the viruses are independent living entities and not of the nature of intrinsic cell ferments or catalysts.

The address was followed by a well-maintained discussion in which a number of active workers in the virus field took part. Dr. Ravers (Rockefeller Institute) emphasised the intimate relation that appeared to exist between the viruses and their host cells as evidenced by the occurrence in certain host cells of inclusion bodies one type of which, notably the Bollinger body of fowlpox, undoubtedly contains virus, and by the fact that positive results in the course of attempts to cultivate viruses *in vitro* had been obtained only when living cells were

present. He and his co-workers had failed to demonstrate growth of vaccinia virus in purely artificial media free of tissue cells. It was fairly obvious from the blackboard schemata which Dr. Ravers had prepared in order to illustrate certain possible ways in which viruses could be explained on an intrinsic or semi-intrinsic basis, that he treated perhaps with unmerited seriousness the opinions of certain pathologists who have recently expressed themselves in a similar strain. Subsequent speakers, from their experience in the plant and animal virus fields, were overwhelmingly of opinion that, for the time being at any rate, the hypothesis that viruses are extrinsic living entities is good enough to work on, seeing that no fact yet established in regard to the features of viruses in general and their reactions both in the body and in the test-tube is incompatible with such hypothesis.

This view was stressed particularly by Dr. Henderson Smith (Rothamsted) from the plant virus side, while in the animal virus field Dr. Bedson (London Hospital) and Dr. C. H. Andrewes (National Institute) emphasised the entire incompatibility of an intrinsic origin with the known facts which have been ascertained with regard to the antigenic individuality of viruses. In no essential particular is their serological behaviour—whether in the body or in the test-tube—different from that of the visible bacteria, and the acceptance of an intrinsic origin would involve assumptions as to



antigen-antibody relationships which run counter to all our accumulated knowledge of serology. As pointed out by Dr W E Gye (National Institute), however, there appeared to be some experimental evidence derived from his work on transmissible fowl tumours that the induction of a tumour by means of a cell-free filtrate is brought about by the co-operative action of two elements, one arising intrinsically and the other (most probably the virus) extrinsically.

Dr G H Eagles (Lister Institute), who has recently reported success in the cultivation of the virus of vaccinia on artificial media free from cells (centrifuged kidney extracts), pointed out that if criticism was directed to these experiments on the ground that the centrifugalisation was incomplete, the very notable multiplication of the virus would have to be accounted for by the presence of such a minimal amount of intact cell substance as could scarcely play any decisive rôle in facilitating growth.

Important evidence was given bearing on the well-founded assumption that, below the smallest visible bacteria, another range of living entities begins, going down, so far as we can judge, to degrees of smallness which, at the moment perhaps, it is difficult to conceive as capable of association with an independent life process.

Prof Ledingham (Lister Institute) discussed the evidence in support of the belief that the large inclusion bodies met with in the epithelial cells in fowlpox are made up of elementary bodies (Borrel bodies) about  $0.2 \mu$  diam, and that these latter are the actual infective agents. He stated that he had recently been able, by a special process of extrac-

tion, to secure pure suspensions of the elementary bodies (Paschen bodies and Borrel bodies) present in the lesions of vaccinia and fowlpox respectively. These suspensions were found to be agglutinated by the sera of animals (rabbits and fowls) in the course of infection with, and after recovery from, vaccinia and fowlpox. This new evidence supported the view that the elementary bodies were of etiological importance.

Mr J E Barnard and Dr W J Elford (National Institute) discussed their recent work on the microscopy of the elementary bodies present in the lesions of ectromelia, the recently discovered disease of mice which, like fowlpox, is associated with the presence of characteristic large inclusion bodies in the epithelial cells of the infected mouse skin. They showed that, as in fowlpox, the inclusion body in this disease is similarly made up of elementary bodies which are also to be found in great numbers in infected organs such as the liver.

The diameter of the elementary body (about  $0.15 \mu$ ), as determined by microscopical methods, agreed closely with that determined from differential filtration methods in which collodion membranes of varying porosity were used. The diameter of the foot and mouth virus particle, on the other hand, when determined by similar filtration methods, in conjunction with biological tests of the filtrates, appeared to be of the order of  $25-30 \mu$ , and thus only some three times larger than the diameter of a hæmoglobin molecule.

The discussion as a whole brought to a focus a number of the more important lines on which virus research is at present concentrating, and the outlook for the future was distinctly optimistic.

### Obituary.

DR GUSTAVE LE BON.

THE death of Dr Gustave Le Bon, at the age of ninety-two years, removes one of the most brilliant and versatile of French savants. Ethnology, sociology, psychology, history, philosophy, and experimental science occupied his attention in turn, and often simultaneously.

Le Bon began his professional career as medical officer of a military ambulance in 1870. His early publications refer to experimental work in physics and chemistry, including a study of the alkaloids of tobacco smoke (1880). An adventurous nature led Le Bon to take part in many explorations and scientific missions, which supplied him with material for several ethnographical and sociological studies, such as "La Civilisation des Arabes" (1884), "Les Civilisations de l'Inde" (1887), "Les Premières Civilisations de l'Orient" (1889). Le Bon came to the conclusion that races differ from one another in the proportion of higher types of individuals that they contain, and that the difference between the sexes becomes greater in the more advanced civilisations.

The writings by which Le Bon was best known are his psychological works. The "Psychology of Crowds", "Psychology of Education", "Psycho-

logy of Socialism", etc., have been very widely read, and have exerted a wide influence on contemporary thought. Le Bon was also known for his pioneer work in connexion with the relation between matter and energy. In 1897, in a communication to the Paris Academy of Sciences, Le Bon declared that all bodies under the influence of light emit radiation capable of rendering the air a conductor of electricity. He pointed out that this radiation was probably related to the cathode rays and to the newly discovered Becquerel radiation from uranium. His opinion that "matter is only a stable form of energy" was considered at the time highly unorthodox and met with vehement opposition. These speculations were brought together in his "L'Évolution de la Matière" (1905) and "L'Évolution des Forces" (1907), the latter of which was translated into English.

Le Bon counted among his friends some of the most distinguished French savants, including Henri Poincaré, Painlevé, and Ribot, and had perhaps more admirers outside France than in his own country. He was born in 1841 at Nogent-le-Rotrou, and died at Marnes-la-Coquette of bronchopneumonia, after a short illness. As director of the Library of the Philosophy of Science, he remained active in scientific matters until the end.

## News and Views.

## New Year Honours.

THE New Year Honours list contains the names of the following scientific workers and others associated with scientific work —*KCMG* · Sir James Kingston Fowler, member of the Colonial Advisory Medical Committee *KBE* Dr F N K Menzies, chief medical officer of the London County Council *DBE* Miss Margaret Tuke, formerly principal of Bedford College for Women, Miss Edith Mary Brown, principal of the Women's Hospital and Christian Medical College, Ludhiana, Punjab *Knights* Mr George Buckston Browne, who purchased the house at Downe, Kent, where Charles Darwin lived, restored and endowed it, and gave it to the British Association in custody for the nation, Dr H H Dale, director-in-chief of the National Institute for Medical Research, Hampstead, Prof P Geddes, emeritus professor of botany in the University of St Andrews and formerly professor of sociology and civics, University of Bombay, Dr H S Wellcome, founder of the Wellcome Research Institution and of the Wellcome Tropical Research Laboratories, Khartoum *CB* Mr F W C Dean, formerly superintendent of the Royal Gun and Carriage Factories, Royal Ordnance Factories *CMG* Dr E. J. Butler, director of the Imperial Mycological Institute *CIE* Lieut-Col J Morrison, director of the King Edward VII Pasteur Institute and Medical Research Institute, Shillong, Assam, Dr N. L. Sheldon, chief inspector of explosives in India. *CBE* Dr Harriette Chick, for services to the Medical Research Council in connexion with research on vitamins and the science of nutrition, Maj T J Hallman, inspector-general of health services, Ministry of the Interior, Iraq; Mr H. H. Humphries, city engineer and surveyor, Birmingham, Mr V A Lowinger, surveyor-general in the Straits Settlements and Federated Malay States, Mr G K Menzies, secretary to the Royal Society of Arts, Mr. R J Mitchell, director and chief designer, Supermarine Aviation Works (Vickers), Limited, for services in connexion with the Schneider Trophy contest, Dr H Moore, director of metallurgical research, War Office, Mr H E Stilgoe, chief engineer Metropolitan Water Board, Mr J M Thomson, secretary for native affairs, Northern Rhodesia, Mr C Weatherill, assistant secretary and acting deputy secretary, Department of Agriculture for Scotland *OBE* Capt B S Cohen, staff engineer, Research Section, General Post Office, Mr A Harker, for services to the Committee for Research in the Dependencies of the Falkland Islands (Discovery Committee), Mr F. A. Innes, medical officer of health, Gambia, Mr R Withycombe, director of the Electricity Department, Zanzibar. *MBE* Mr W N Booth, assistant mechanical engineer, Royal Ordnance Factories, Woolwich, Mr C J Colvin, assistant engineer, Irrigation, Ministry of Economics and Communications, Iraq, Mr W W D Dale, engineering assistant to the Director of Dockyards, Admiralty,

Mr J E Lesslar, formerly senior deputy pathologist, Institute for Medical Research, Federated Malay States

## Dr D H. Scott

DR D H SCOTT has recently received a diploma of congratulation from the Bavarian Academy of Science, through its president, Prof K Ritter von Goebel, on the jubilee of his degree of Ph D of the University of Wurzburg. The degree was conferred on Dr Scott on July 20, 1881. Dr Scott is known chiefly for his work in palaeobotany and in this field he has earned a world-wide reputation. He was elected a fellow of the Royal Society in 1894, and was awarded a Royal Medal in 1906 for his investigation and discoveries in connexion with the structure and relationships of fossil plants, and the Darwin Medal in 1926 for his work on the Pteridosperms. Prof von Goebel, through whom the congratulatory diploma was sent, was elected a foreign member of the Royal Society in 1926. He is well known for his studies in plant organography, and is an authority on the Bryophyta. This recent further recognition of one of the leading British botanists by his German colleagues is a graceful tribute which will be widely appreciated.

## Synthesis of Vitamin D.

THE announcement appeared in *NATURE* of Oct 31, 1931, p 758, of the preparation of 'calciferol', a crystalline compound of the highest known vitamin D activity, by a team of workers at the National Institute for Medical Research, under the leadership of Dr Bourdillon. Calciferol is probably the pure vitamin, although this is not quite certain. Members of this group of compounds, in mixtures of varying composition, frequently form crystals which cannot be separated into their components by simple recrystallisation but only by the formation of derivatives. Calciferol is formed from ergosterol by the action of ultra-violet rays, and up to the present no other method of conversion of ergosterol into vitamin D has been successfully used. It is now reported in the *Times* of Jan 1 that C E Bills and F G McDonald, of Evansville, Indiana, U.S.A., have claimed the first chemical synthesis of this vitamin, in a paper at the recent meeting of the American Association for the Advancement of Science. They treated ergosterol with methyl alcohol, ether, and ethylacetate under low temperature, with a rigid exclusion of oxygen, and obtained the vitamin, but in less pure form than by the irradiation of ergosterol.

SYNTHESIS of vitamin D without the use of ultra-violet rays is of very great interest. The fact that the product is of only low activity indicates that it is impure. This work suggests a number of further problems for elucidation. Will the vitamin so prepared, when isolated in pure form, be the same as 'calciferol'? *A priori*, this might be expected

Again, will the method be simpler to use than that involving the use of ultra-violet rays, and will the conversion be more quantitative as the method is improved? It will also be of interest to observe whether the methods used by Bourdillon and his collaborators in England and by Windaus at Göttingen in the separation of the vitamin from its accompanying impurities in irradiated ergosterol are applicable to 'chemically-treated' ergosterol. Further details of Bills and McDonald's process will be awaited with interest.

#### Power Stations and Air Pollution.

DURING the past two years, public attention in Great Britain has been focused on the question of air pollution due to the operation of super-power electric stations. In his recent presidential address to the Junior Institution of Engineers, Dr S. L. Pearce, engineer-in-chief of the London Power Company, discusses this problem and others of great importance at the present time owing to the practice of concentrating more and more power in single generating stations. Efficient measures are available for preventing the pollution of the atmosphere by the smoke and ash from chimney-stacks when stoker-fired boilers are used, but when pulverised fuel is adopted the problem becomes more difficult, owing to the fineness of the dust content of the ash. The recent controversy about the new Battersea power station had reference to the much more difficult problem of arresting the possible damage to buildings and vegetation, and the alleged danger to life, due to the sulphur oxides contained in the products of combustion issuing from the chimneys.

Most of those who discussed this problem attributed the pollution of the atmosphere mainly to the power stations. That some of it is due to this cause every one admits, but the great bulk is due to the many industrial power plants and the hundreds of thousands of domestic chimneys. Effective measures are now available for eliminating smoke and the ash and dust content of flue gases. Cyclone plants, spray and film washers, and electrofilters all find a place in modern power stations. In conjunction with these, however, it is necessary to erect chimneys at least 300 ft in height. During the last three years, by the collaboration of engineers and chemists, much research work has been carried out by the London Power Company, experimental plants have been erected, and the results obtained have proved conclusively that the emission of sulphur fumes can be reduced to a negligible quantity.

#### Akhenaton's Mummy.

THE consternation aroused a few weeks ago by the reported discovery that the mummy of Akhenaton exhibited in the Cairo Museum was not that of the famous monarch, and the suggestion that a substitution had taken place, has now been allayed in some degree by the announcement that it is the identity of the mummy that is in question. Dr D. E. Derry and Mr. Rex Engelbach, curator of the Egyptian Museum, in a joint lecture at Cairo, as reported in the

*Times* of Jan. 2, have now put forward the view that the mummy hitherto regarded as that of Akhenaton is really that of Smenkara, a son-in-law of Akhenaton, who used the royal name in his cartouche, hence the confusion. This mummy has presented some elements of doubt from the time of its discovery. It was found in 1907 in the Valley of the Kings, in a tomb supposed to be that of Queen Tiye. When it was examined by Prof. Elliot Smith, the condition of the bones was such as to suggest that they belonged to a young man who, at the time of his death, was not more than twenty-five years of age. As this seemed difficult to reconcile with the known facts that Akhenaton had reigned for seventeen years and had six daughters, Prof. Elliot Smith suggested that the king might have suffered from a rare affection which would have delayed the consolidation of the bones perhaps for as much as ten years beyond the normal ("The Royal Mummies", pp. 52-53). Dr. Derry, as a result of experience in the examination of the modern Egyptian youth, now thinks that the mummy may be that of an individual of even less than twenty-five years of age, in view of the early age at which maturity is attained in Egypt. Further, the bulbous head, well known in the representations of Akhenaton and taken by Prof. Elliot Smith in the actual skull to be due to a slight degree of hydrocephalus, is regarded by Dr. Derry as a characteristic of Egyptian royalties.

#### Exhibition by the Royal Meteorological Society

AN exhibition is being arranged by the Royal Meteorological Society, to be held in the Geophysical Gallery of the Science Museum, South Kensington, by permission of the director, Sir Henry Lyons. The exhibits will include modern types of observing instruments approved by the Meteorological Office, such as the latest type of thermometer screen with steel stand, equipped with sheath thermometers, the sunshine recorder Mark II, with adjustments for level and azimuth, a new form of mountain rain-gauge which has been named the 'octapent' mountain rain-gauge, and a stream-lined wind-vane which embodies a number of new features—these are being lent by the director. Several stands of instruments of special interest will be shown by some of the leading British makers, among which will be a model anemometer, a new form of automatic pollution gauge, and examples of 'distant-reading' thermometers. A number of historic instruments will be shown, and another exhibit will illustrate the development of lightning conductors.

OTHER features of the exhibition will be a magnificent collection of cloud photographs, including a series arranged by Sir Gilbert Walker, showing recent work on the artificial production of cloud forms. There will be a small exhibit illustrating the teaching of weather study in schools. The exhibition will be opened at 5 P.M., on Jan. 11, when a short inaugural address will be given by Sir Napier Shaw in the lecture theatre. The exhibition will remain open for one month, during which public lectures will be given on Thursdays at 4.30 P.M. The programme as provisionally arranged is as follows: Jan. 14—Mr. D.

Brunt, on "Meteorology in History", Jan 21—Dr G C Simpson, on "Weather Forecasting", Jan 28—Capt C J P Cave, on "Clouds", and Feb 4—Sir Henry Lyons, on "Historic Meteorological Instruments"

#### Blind Reading Print by Sound

ACCORDING to a report in the *Times* of Jan 1, two French inventors, MM Thomas and Conland, have devised an apparatus by which ordinary print can be made legible for the blind. The apparatus is called the photoelectrograph. A ray of light is made to pass over the printed page, and as each letter is illuminated the corresponding letter is presented in relief and in magnified form in another part of the machine, where the blind reader identifies it by touch. Not only ordinary print, but also Braille can be read with the machine, in the latter case it has the advantage that the Braille characters can be printed with ink on a smooth page and need be no larger than ordinary type, thus reducing Braille types to a convenient size and making them cheaper and easier to produce than hitherto. Any reduction in the size of the present Braille publications in embossed type must be a boon, but institutions for the blind in Great Britain will probably continue to use an instrument which involves no special printing, and—like Dr Fournier d'Albe's 'optophone' or Prof F C Browne's 'phon-opticon'—directly converts ordinary type into sound signals. Moreover, experience has shown that ordinary type, even after enlargement, is unsuitable for reading by touch with any speed.

#### Scientific Research and the Electrical Industry

WE learn from *A E G Progress* for October that owing to the present trade depression, the German electrical industry is being compelled to exercise the most rigid economy. On the other hand, it is doing its utmost to explore the possibilities of new sources of revenue. To achieve this, it is relying on scientific research and on utilising the results obtained in industry and agriculture. It is recognised that many of the benefits conferred on the civilised world during the last two generations have been due to the close co-operation between the research worker and the engineer. The Research Institute of the A E G, which commenced work as a private institute several years ago, has now opened its doors to a wider public and to the Press. Prof Ramsauer is the head of the Institute and has forty scientific workers under him, the problems investigated covering a wide field in physics, chemistry, and engineering. The field of purely scientific research is the field in which the Institute is least fettered, as the question of technical application is of secondary importance. In fact, technical considerations may be a drawback, as a pre-determined purpose cramps scientific research and may even lead it astray. Only when the investigations have been carried to a conclusion, uninfluenced by preconceived ideas, is the possible use of the technical applications of the results considered. In this way the nature of the electron was investigated in the physical laboratory and the conclusion arrived at that its behaviour is similar to that of a wave. It

is stated that the use of electron waves for surface structure analysis represents a valued and important application of the knowledge thus obtained.

#### Soap Plants

ETYMOLOGY, pharmaceutical lore, and wide knowledge of ancient herbals and modern systematic botany are combined in the fascinating series of articles contributed by Mr Hilderic Friend to the *Gardeners' Chronicle* under the general title of "Horticulture in relation to Commerce". The article in the issue for Nov 28 points out how varied are the plants and parts of plants that have been used by native races as soap materials. As a result, the identification of a plant simply named a soap plant or soapwort is not an easy matter. One tropical family, the Sapindaceæ, represented commonly in Great Britain by the horse-chestnut, contains a number of soap plants, including the soap-tree of China, *Sapindus chinensis*, the fruit of another species is used in India under the name of soap nut, whilst Humboldt describes the natives on the river Carriaco washing their linen with the fruit of the parapara (*Sapindus Saponaria*). In California is found a large bulb, *Chlorogalum pomeridianum*, of which the mucilage provides a lather, whilst the root of *Gypsophila Struthium*, a native of Spain, lathers in water. In fact, decoctions, roots, barks, fruits, and seeds have all been utilised, whilst the modern soap industry probably had its origin in the value, very early discovered, of certain plant ashes as cleansing agents. Thus, Pliny states that soap was first prepared by boiling goat's fat with ashes from the beech tree.

#### Strength of Burmese Timbers

A PAPER comparing timbers of Burma with those of Europe and America, by Mr C W Scott, of the Indian Forest Service, was recently presented to the Association of Engineers in Burma (Paper No 3, July 23, 1931, Session 1931). Timber testing is now an economic art practised in many countries either anxious to place new untried timbers on the markets or to procure cheaper ones to replace more expensive types. Most of the important timbers of Burma have now been tested for strength on standard scientific lines at the Forest Research Institute, Dehra Dun, India. The data obtained there are readily comparable with those recorded by similar apparatus and procedure in the United States, Canada, and Great Britain. Timber testing has indeed become a highly organised branch of science in the last twenty years. It is conducted under the supervision of trained engineers well acquainted with engineering practice and requirements in metal and other materials as well as in wood. In France and Germany a certain amount of special timber testing has been done in connexion with aircraft, but apparently no standard procedure for general timber testing has been evolved. The standard methods used at Dehra Dun are being followed also in Australia, New Zealand, South Africa, the Malay States, the Philippines, and Java. Mr Scott's paper is of value, since the data of comparison have been collected from the laboratories of Dehra Dun (India), Madison (U S), Princes Risborough

(England), and the Forest Products Laboratories of Canada. From the point of view of Burma, it places that country in a position to answer inquiries on the subject of strengths, etc., of her more important timbers, information on the subject being obtainable from the Forest Economist, Rangoon.

#### American Museum of Natural History

THE standing and the progress of the American Museum of Natural History illustrate what can be attained by effort over a relatively limited field so long as public interest approves and lends its support. On the common ground of the great public educational purposes served by the museum, the City and State of New York have combined in granting appropriations for building alone of 16,000,000 dollars, and the increasing extent of the services rendered may be judged from the jump which is foreshadowed in annual expenditure, from the "inadequate sum" of 15,000,000 dollars in January 1931 to an amount of 22,500,000 dollars in 1933, when the building programme will be completed, and the exhibition halls, laboratories, and lecture halls will be in full operation (Sixty-second Annual Report of the Trustees for the Year 1930). A new feature of the museum's educational programme is the development of the training of teachers, for whom three special courses have been instituted. But the school services also increase by leaps and bounds, so that the 23,000,000 contacts with school children in 1930 almost double those of the year before. The lantern slides loaned to public schools well exceeded a million, and it is interesting to find that the growth of the film service shows that for class purposes the narrow width film (16 mm) is more appreciated as an aid in teaching than the standard (35 mm) film, the real place of which is the assembly hall.

#### National Museum of Canada

THE National Museum of Canada, the Annual Report of which for 1929 has just been published, attains a happy balance in its combination of field and indoor work. During the summer months the members of the staff are engaged in field work broadly distributed throughout Canada, a tradition doubtless derived from the Museum's close connexion with the Geological Survey. The result is of value scientifically and educationally. Ethnological expeditions in many areas, the investigation of the mammals of British Columbia and of the plants of Wood Buffalo Park, add material to the collections and valuable experience to the collectors, who take the opportunity of delivering popular lectures in the districts they visit. In the Museum itself great stress is laid upon the need for making a reasonable contribution to the interests of the community, and the variety of the titles in the list of the two popular lecture courses, delivered during the winter in the auditorium, indicate one way in which that contribution is successfully made. Nearly 9000 children attended the Saturday morning lectures and 3323 adults those on Wednesday evenings.

#### Literature of Nutrition.

THE scientific investigation of nutritional problems has attracted so many workers to this field that it is

difficult for anyone to keep in touch with advances made in directions other than those in which he is immediately engaged. We therefore welcome the appearance of the first two parts of vol. 1 of *Nutrition Abstracts and Reviews*. This new journal is issued under the auspices of the Imperial Agricultural Bureaux Council, the Medical Research Council, and the Reid Library of the Rowett Institute, Aberdeen. The editors are Dr J B Orr, Prof J J R Macleod, and Dr Harriette Chick. The first number, a double one, contains 351 pages and 1334 abstracts. Reviews are contributed by Sir F Gowland Hopkins on nutrition and human welfare, Prof E P Cathcart on some of the difficulties in the quantitative assessment of human diets, and Dr J B Orr on the qualitative aspects of nutrition, with special reference to farm animals. The journal will appear quarterly. Abstracts will be made from some 450 periodicals, and the reviews will be of two types, those of a general nature, stating a point of view, as in the present number, and others dealing exhaustively with the present state of knowledge of different aspects of the subject, giving a bibliography of the literature. A hearty welcome may be extended to the new journal, which will be invaluable to workers in this science and of great use as a work of reference.

#### British Salmon Fisheries in 1930

THE Ministry of Agriculture and Fisheries Report on the Salmon and Freshwater Fisheries for the year 1930 brings to our notice that that year was characterised throughout Great Britain by the marked shortage of salmon from our rivers. Furthermore, this had followed on from a shortage that was already apparent in 1929. In both years it was the four-year-old fish which failed to come up to number, which indicates that for some reason the smolt crop of two successive seasons, in 1927 and 1928, has not returned from the sea. All available evidence goes to show no reason that would cause the smolt run from the rivers to the sea in those years to have been a failure, and one is left to conjecture that "unfavourable factors in the sea caused the destruction of the main body of smolts which descended." With most of our food fish from the sea, the abundance of future stocks is probably determined at a very early stage of the fish's life—during the first year at any rate, as shown by the successive predominance of one-year's stock from year to year in the catches. It is easy to imagine factors which may bring about heavy mortality when the fish are at a young and delicate stage, or that may even curtail spawning efforts, but the salmon are already sturdy grown fish by the time they enter the sea, and, barring excessive depredation by enemies, it is difficult to suggest a reason for their non-return.

#### Cattle Diseases in Australia.

AFTER considerable delay, arrangements have now been completed by the Australian Council for Scientific and Industrial Research for the carrying out of research work into cattle diseases in northern Australia. The Empire Marketing Board is generously meeting half the cost, up to a maximum of £5000 per annum, the Queensland Government is providing £1000 annually

and is making available its station at Townsville, the cattle industry of the State will provide £2000, to be raised by a compulsory annual levy of 1s on every hundred head of cattle other than dairy herds, the Queensland Council of Agriculture has offered £300, and it is hoped that the meat exporters will provide the balance. Dr A. W. Turner will be in charge of the station, with Dr John Legg as chief assistant. In pursuance of the policy of linking together work in different parts of the Empire by personal contact between investigators, Dr Legg is at present in South Africa studying the problems and organisation of the Veterinary Research Institute at Onderstepoort.

#### Germ of Infantile Paralysis

PROF. FREDERICK EBERSON, director of clinical laboratories and research at the Mount Zion Hospital, San Francisco, announced at the recent meeting of the American Association for the Advancement of Science that he has succeeded in cultivating the virus of poliomyelitis (infantile paralysis) in a special culture medium, and in reproducing the disease in the monkey by inoculation of the culture. The virus has long been known as an invisible and filterable one, in which state it is present in the brain and spinal cord of the patient, but in the culture it is claimed that it becomes larger and assumes a form which is just visible microscopically.

#### Announcements

WITH the year 1931, Prof. Luigi Palazzo closed his long and valued service as director of the Central Office of Meteorology and Geophysics at Rome, in which he followed the late Prof. Pietro Tacchini thirty years ago. With his work as director, he also combined the guidance of the Italian Seismological Society. He is succeeded by Prof. Emilio Oddone, until lately the head of the Geophysical Section of the Central Office. Two months earlier, Prof. G. Agamennone also retired from the directorship of the Royal Geophysical Institute of Rocca di Papa, to which he was appointed thirty-two years ago after the death of Prof. M. S. de Rossi.

IN view of the disturbed economic and financial conditions that prevail in Europe and America, the Council of the Institute of Metals has found it necessary to postpone this year's meeting, which was to have been held in the United States and Canada next autumn. The meeting had been planned with the close co-operation of the American Institute of Mining and Metallurgical Engineers. The Council's suggestion that the meeting be postponed was sympathetically received in America, and the assurance has been made that the members will be welcome at such later time as may suit their convenience.

MESSRS. Watson and Sons (Electro-Medical), Ltd., Sunic House, 43 Parker Street, Kingsway, W.C.2, have issued a booklet containing a description of their apparatus for, and full details of, 'surgical diathermy'. This is a procedure by which a high-frequency alter-

nating current is concentrated at a small electrode in the form of a short knife edge, so that a small 'cutting' arc is produced, which takes the place of the scalpel or knife ordinarily used in surgical operations, burning instead of cutting through the tissues.

A COLLECTION of collotype reproductions of early English county maps is announced for immediate publication by the Royal Geographical Society. Twenty-one sheets from the collections of the Society have been chosen to represent the chief cartographers and the engravers employed by them. The reproductions will include specimens of the work of Saxton, Symonson, Camden, Speed, and others, with notes by Mr. E. Heawood.

MESSRS. G. Bell and Sons, Ltd., announce the forthcoming publication, in a limited edition, of the diary of Michael Faraday, covering Faraday's experimental work between the years 1820 and 1862. The diary will be issued in seven volumes. Messrs. Bell also promise an account of Prof. Donnan's experiments with membrane equilibria, and the discoveries resulting from them. The author is Dr. T. R. Bolam, and the title of the volume "The Donnan Equilibria."

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.—A lecturer in electrical engineering at the Swindon Technical College—The Principal, College, Swindon (Jan. 12). A Goldsmiths' professor of metallurgy in the University of Cambridge—The Vice-Chancellor, The University, Cambridge (Jan. 16). An assistant master at the Bolton Municipal Technical College, for chemistry and physics—The Director of Education, Education Office, Nelson Square, Bolton (Jan. 16). An assistant lecturer in engineering at the Brighton Technical College—The Secretary, Education Offices, 54 Old Stene, Brighton (Jan. 16). An advisory officer in agricultural economics at the Edinburgh and East of Scotland College of Agriculture—The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh (Jan. 18). An assistant curator in the Raffles Museum and Library, Singapore—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1 (Jan. 30). A works superintendent and chief engineer at the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (Jan. 30). A pathologist in the Public Health Department of the Corporation of Glasgow—The Town Clerk, City Chambers, Glasgow (Feb. 1). A medical man for research work under the British Empire Leprosy Relief Association (Indian Council), in collaboration with the Calcutta School of Tropical Medicine and the All-India Institute of Hygiene—The Honorary Secretary, British Empire Leprosy Relief Association (Indian Council), Talkatora Road, New Delhi, India (Feb. 29). A male assistant superintendent of traffic in the London Telephone Service, and a male assistant traffic superintendent in the Provinces, G.P.O.—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (March 3).



### Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

#### Thermoclines in Tropical Lakes.

THE thermocline is a feature of most temperate lakes during the summer months, and is normally destroyed during the winter by a complete overturn of the water, due to cooling at the surface. Little work has been done, however, on such conditions in equatorial lakes, where there is no marked seasonal difference in temperature.

F. Ruttner<sup>1,2</sup> has recently published detailed work on a series of lakes in Java, Sumatra, and Bali. As a general rule, in the smaller lakes of the order of 1-2 square km (surface area) he found well-marked thermoclines at depths of 2-8 metres. In larger lakes, layering of the water was less marked. In Lake Toba, in area about 1000 square km, the largest lake examined, he found no layering in the upper 20 metres, but a thermocline of a more gentle gradient at a depth of 25-70 metres was detectable. Ruttner concludes that wind is the important factor in preventing the development of thermoclines, and that therefore in the larger lakes, where winds have greater effect, thermoclines are less evident, their presence or absence being quite independent of the depth of the

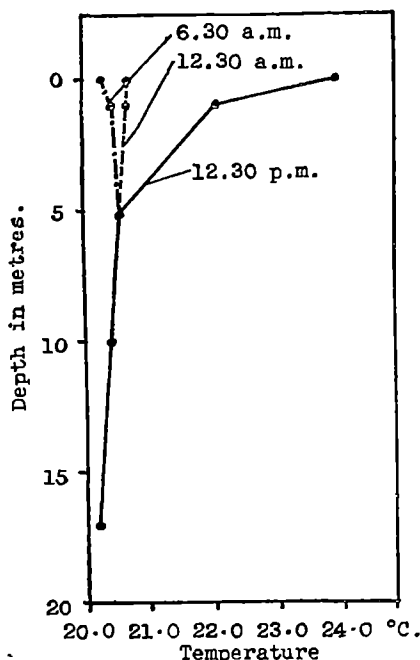


FIG 1

lakes. In a few cases he was able to observe the development of a thermocline during the course of a few days in lakes which were previously mixed by heavy winds. He considers such mixing by wind to be comparatively rare, the stable condition being that of layering with a well-marked thermocline near the surface.

After two expeditions studying limnological problems in the African equatorial regions, we can say that no thermoclines are developed in the following lakes,

all of which are deep enough to produce either of the types described by Ruttner: Lakes Rudolf and Naivasha in Kenya, Lake Bunyoni in Uganda, and the Victoria Nyanza. Our conclusions are derived from a large number of observations on temperature, alkalinity, hydrogen ion concentration, and phosphate content at different times of the day and night. As a general rule, the water from surface to a depth of two or three metres heats up several degrees during the day, and complete mixing takes place at night, so that from midnight onwards the temperature curve

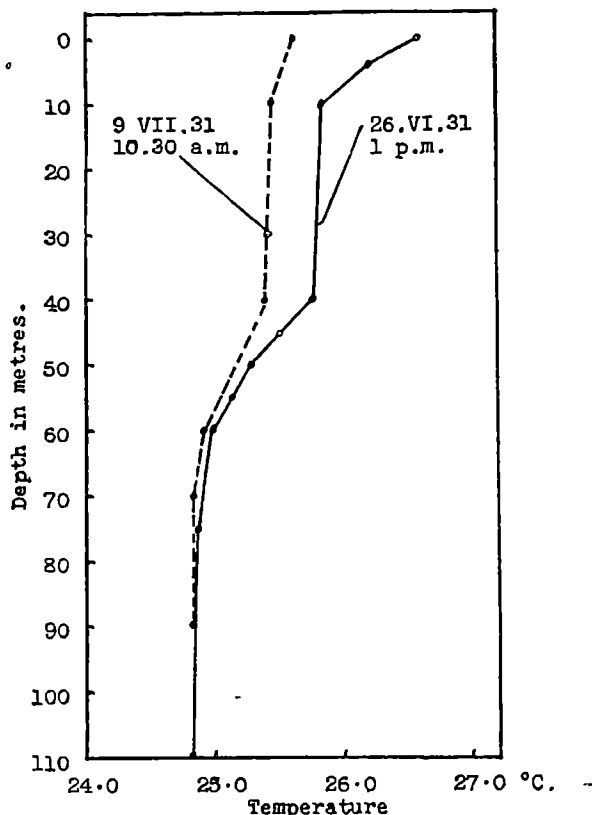


FIG 2

is vertical or even reversed in the upper few metres, as illustrated in Fig. 1 for Lake Naivasha.

These results confirm Ruttner's conclusions with regard to area and wind mixing, since all of those lakes mentioned are of the large type, with areas of more than ten square km, and range up to the enormous area of Lake Victoria. But the wind effect, if responsible, produces even greater mixing, in that no thermoclines were detected at any depth.

In Lake Edward, however, a large rift lake in Uganda with a depth of 117 metres, a very marked thermocline was found at the considerable depth of 40-60 metres. This is illustrated in Fig. 2. Lake Edward has an area of about 1500 square km, and its surface is much disturbed by winds, so that there seems no reason why a thermocline should develop there and not in Lake Rudolf or Lake Victoria. Fig. 2 shows that the upper 40 metres of Lake Edward would constitute a lake similar to Lake Naivasha with a regular heating and cooling of the upper three or four metres, suggesting that the thermocline from 40 metres to 60 metres is not due to the ordinary sun-heating at the surface. The water below the thermocline smelt strongly of hydrogen sulphide, that of the epilimnion

was odourless. The only explanation that we are able to offer for this remarkable thermocline of Lake Edward is that the heavy layer of more saline water in the hypolimnion has been introduced by rivers from the surrounding volcanic regions or from underground sources, and is prevented from mixing with the epilimnion owing to its greater density. We should suggest that the thermocline found by Ruttner in large lakes, such as Lake Toba, may also be of this nature and not a true temperature thermocline.

E. B. WORTHINGTON  
L. C. BEADLE

Zoological Laboratory,  
Cambridge, Dec. 4.

<sup>1</sup> *Archiv für Hydrobiol.* Suppl., Bd. 8, p. 197, 1931.  
<sup>2</sup> *Verhandl. der Intern. Verein. für Limnol.*, Bd. 5, p. 44, 1931.

### Anomalous Scattering of $\alpha$ -Particles by Hydrogen and Helium

It is well known that when light is scattered by an object small compared with the wave-length, the scattered wave is spherically symmetrical. Similarly, in the wave mechanical treatment of the scattering of  $\alpha$ -particles by hydrogen and helium, the ' $\alpha$ -particle wave' scattered by the nucleus will differ from that scattered by a Coulomb field only by the spherically symmetrical wave scattered by that region (small compared with the wave-length of the incident  $\alpha$ -particles) where the interaction energy differs from the Coulomb value. Thus, without any specific model of the nucleus, we deduce that the anomalous scattering at a given velocity should be expressible in terms of a single parameter only, which determines the amplitude of this spherically symmetrical wave. Denoting by  $R$  the ratio of the number of  $\alpha$ -particles scattered through an angle  $\phi$ , to the number predicted by the inverse square law, it is shown in a recent paper<sup>1</sup> that, for scattering in helium,

$$R = \frac{\text{cosec}^2 \phi e^{-i\alpha \log \sin^2 \phi} + \sec^2 \phi e^{-i\alpha \log \cos^2 \phi} + 2i(e^{2i\alpha K} - 1)/\alpha}{\text{cosec}^4 \phi + \sec^4 \phi},$$

where  $K$  is the single parameter referred to, and  $\alpha = 8\pi e^2/vh$ ,  $v$  being the velocity of the incident  $\alpha$ -particles. A slightly simpler formula of the same type is found for scattering in hydrogen.

The experimental value for  $R$  at one given value of  $\phi$  and  $v$  determines  $K$  for that velocity, and the formula will then predict  $R$  for other angles. It has been found that the formula gives good agreement for the angle distribution in both helium and hydrogen, accounting even for the anomalous scattering at small angles, as is illustrated in the accompanying tables.

#### SCATTERING IN HELIUM

$v = 1.73 \times 10^9$  cm/sec  $K = 1.65$

| Angle ( $\phi$ )            | 10°  | 34° | 45°  |
|-----------------------------|------|-----|------|
| $R$ (calculated)            | 0.62 | 3.8 | 8.0  |
| $R$ (observed) <sup>2</sup> | 0.56 | 3.6 | 8.0* |

#### SCATTERING IN HYDROGEN

$v = 1.84 \times 10^9$  cm/sec  $K = 0.96$

| Angle ( $\phi$ )            | 0°-10° | 10°-15° | 15°-20° | 20°-21°-31°-2' | 30°-40° | 40°-50° | 50°-60° |
|-----------------------------|--------|---------|---------|----------------|---------|---------|---------|
| $R$ (calculated)            | 42     | 43      | 39      | 29             | 17      | 7.8     | 2.4     |
| $R$ (observed) <sup>3</sup> | 44     | 50      | 48      | 29*            | 13      | 7       | 1.4     |

\* The values marked with an asterisk were used to determine  $K$ .

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If the values of  $K$  are calculated for two or more different velocities, they can be used to determine a model for the nuclear field. This model is spherically symmetrical and is of the type already postulated by Gamow to account for radioactive phenomena. Thus the wave mechanical solution of the scattering problem avoids the difficulty encountered by classical mechanics whereby the anomalous scattering at small angles required a nucleus with different properties in different directions.

H. M. TAYLOR  
Clare College, Cambridge,  
Dec. 3

<sup>1</sup> Taylor, *Proc. Roy. Soc. A*, vol. 134, p. 103, 1931.  
<sup>2</sup> Rutherford and Chadwick, *Phil. Mag.*, vol. 4, p. 605, 1927.  
<sup>3</sup> Chadwick and Bieler, *Phil. Mag.*, vol. 42, p. 923, 1921.

### Nuclear Spin and Hyperfine Structure in Band Spectra.

RECENTLY, S. Mrozowski<sup>1</sup> has found that the band lines in the spectrum of mercury hydride (HgH) are split into several narrow components of constant or nearly constant separation (~0.02 Å). The bands investigated belong to a sequence  $v' = 0, v'' = 0, 1, 2, 3$  in the transition  $^2\Pi_{1/2} \rightarrow ^2\Sigma$ . Apparently the approximate formula for the isotope effect in band spectra,  $\Delta\nu_i = \delta(\frac{1}{2}\nu_{\text{osc}} \pm \nu_{\text{rot}})$ , fails completely to explain this case, and so Mrozowski concludes that the separation may be interpreted as a hyperfine structure in a more restricted sense, that is, it is caused by the magnetic or electric constitution of the atomic nuclei.

The isotope formula above, however, is not applicable to this case, the normal state  $^2\Sigma$  forming a unique example of an unstable molecule. The following figures on the vibrational effect, calculated with the aid of the more correct formula of Birge,<sup>2</sup> may be taken as an evidence for this:  $\Delta\nu_{\text{osc}}(\frac{2}{3}, \frac{2}{3}) = +0.017, -0.031, -0.049, -0.026$  cm<sup>-1</sup> in the (0, 0), (0, 1), (0, 2), (0, 3) bands respectively. In the lines investigated by Mrozowski, the rotational isotope effect is predominant, but using Birge's formulae, I find a reasonable agreement with his data. Thus, the arguments for a nuclear spin effect in the mercury hydride bands considered are of little weight. It may also be mentioned that R. Rydberg,<sup>3</sup> analysing the ultra-violet spectrum of mercury hydride with a spectrograph of high resolving power (~300,000), found a fair agreement between the observed and the calculated isotope effect.

Investigating the band spectrum of bismuth hydride (BiH), Mr. A. Heimer and I had good reasons to search for an eventual hyperfine structure, arising from the high nuclear spin ( $i = 9/2$ ) in the bismuth atom. A band system  $^1\Sigma^* \rightarrow ^1\Sigma$ , already reported,<sup>4</sup> showed no effect, the lines being extremely sharp. However, pursuing the analysis of a  $^1\Sigma^* \rightarrow ^1\Pi$  system in the red part of the spectrum, a small but distinct broadening of the first few lines in the series was observed and can be interpreted as an effect of the nuclear spin in bismuth.

The rôle played by the nuclear spin in the vector model of a diatomic molecule is analogous to that of the spinning electron in Hund's cases  $a$  and  $b$ . The energy of interaction between nuclear spins and the electronic system in the model of fixed centre is then given by  $(a_1 i_1 + a_2 i_2)A$ ,  $a_s$  and  $i_s$  denoting the coupling factor and the spin component along the figure axis of the molecule, while the mutual interaction between both spins,  $a_{12} i_1 i_2 \cos(i_1 i_2)$ , is omitted on account of its smallness. Accordingly, the hyperfine structure of electronic terms is limited to the cases  $\Lambda > 0$  ( $\Pi, \Delta, \Gamma$  terms),  $\Sigma$ -terms showing no effect. In the rotating model this coupling will break down as  $K$ , the quantum number of rotation, increases.

From the observed doublet separation in terms of one-electron molecules ( $\text{ZnH}$ ,  $\text{CdH}$ ,  $\text{HgH}$ ) the strength of the magnetic field, induced by the rotation in  $\text{BiH}$ , may be estimated, and it was found that a complete Paschen-Back effect appeared already for  $K > 3$ , causing the disappearance of the hyperfine structure. This behaviour of the model corresponds to the observations noted above. For large  $K$ -values (case  $b'$ , also including  $^1\Sigma$ -terms) a kind of rotational hyperfine structure should appear, due to an orientation of the nuclear spin to the axis of rotation. In  $^1\Sigma^+ \rightarrow ^1\Sigma$  the calculated width of lines due to this effect,  $\sigma_{\text{H}} g_i$  ( $i_K = +i, i-1, -i$ ), amounts to  $\sim 0.02 \text{ A}$ , which, however, is still too small to be distinguished from other factors governing the line width. It would appear from what is said above, that the  $\text{BiH}$  molecule is not a favourable one for such observations, lighter molecules are to be preferred. I also wish to emphasise that my interpretation of the effect is not observed, the hyperfine structure of the band lines not being resolved.

In addition, we must take into consideration that in some atoms deviating properties in the electric field of their isotopes have been observed, as clearly indicated in the case of neon. It is difficult to overlook the molecular effect resulting from this factor. Investigations are being pursued on both sides of this problem.

E HULTHÉN

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Dec 4

<sup>1</sup> S. Mrozowski, *Zeit. für Phys.*, **72**, 776, 1931.

<sup>2</sup> B. A. Brice, *Phys. Rev.*, **35**, 966, 1930.

<sup>3</sup> R. Rydberg, *Zeit. für Phys.*, **73**, 74, 1931.

<sup>4</sup> A. Heimer and E. Hulthén, *NATURE*, **127**, 557, 1931.

#### Significance of Velocity Measurements in Relation to the Benzene Substitution Problem.

From the results obtained by Holleman,<sup>1</sup> Huckel<sup>2</sup> has calculated the relative action constants and the differences between the energies of activation for the nitration of certain benzene derivatives in the ortho, meta, and para positions. The energy of activation for the ortho position is found to be greater than that for the para, and at the temperature used the amount of ortho derivative formed is smaller than that of para in the case of chlor- and brom-benzene, and the exception found in the case of toluene may be met by allowing for the double opportunity of ortho substitution as compared with that of para. These results are interesting from the point of view of steric hindrance. The equality of the action constants taken in conjunction with the facts given above shows that the lower rate of reaction observed for the ortho position is not due to steric hindrance acting on an activated molecule but to an actual paucity of activated molecules due to a difference in activation energy.

The close connexion between substitution problems and the reactivity of substituents attached to the benzene nucleus encourages me to report here the results of some experiments on the velocity of reaction between ortho, meta, and para toluidines and benzyl chloride. I have found that the energy of activation of the ortho compound is distinctly higher than that for the para compound, so that here, as in the case of direct substitution, the lower rate of reaction is not due to steric hindrance acting on activated molecules but to a paucity of active molecules. The steric effect, then, of the methyl group in the above case acts directly on the nitrogen atom by increasing the value of the energy necessary to bring it to the activated state. There is thus apparently a sort of co-ordination between the methyl group and the amino group, of a

kind possibly similar to that postulated by Sidgwick in similar cases.

Where three atoms or groups,  $A$ ,  $B$ , and  $C$ , are present in the vicinal or 1 2 3 positions, then if  $B$  is exerting an effect of this kind on  $C$  the presence of  $A$ —if its demand is greater than that of hydrogen—by sharing and so reducing the effect of  $B$  may raise the reactivity of  $C$ , this kind of effect was observed by Menschutkin in the case of vicinal  $o$ -xylydine. Other evidence of something in the nature of direct chemical interaction between the methyl and amino groups in ortho toluidine and its derivatives is the way in which ortho toluidine frequently imitates the behaviour of secondary bases and monoalkyl derivatives imitate tertiary bases. To return to the general case, when  $A$  or  $C$  is a hydrogen atom, the case reduces to the substitution of a disubstituted benzene derivative.

A vicinal effect of a different kind was observed by Holleman<sup>3</sup> in the case of 1 nitro 2, 6 dichlorobenzene, which may possibly be explained by a sharing of the activating effect of the nitro group.

There is, however, another point worthy of consideration. If the action constant were really a function of the form  $ae^{-b/T}$  then the effect of a variation in  $b$  would only be shown in the so-called energy of activation, the variation in which might be only partially due to a change in the real energy of activation. In the case of ortho toluidine, for example, the life of the activated amino group—which would presumably affect the action constant—might be appreciably affected by the ease of interchange of activation energy between the amino group and the adjacent methyl group, and if the probability of this interchange were of the required form then the observed energy of activation would contain a disguised 'action constant' term. It would appear that the question of the factors governing the lives of active molecules is one of primary interest in this connexion, a kind of molecular insurance office is, in fact, required.

I may add in conclusion that the activation energy of meta toluidine was of the order predicted by the Lapworth-Robinson hypothesis, and that these experiments will be resumed shortly.

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<sup>1</sup> *Rev. Tran. Chem.*, **18**, 267, et seq., 1899.

<sup>2</sup> "Theoretische Grundlagen der organischen Chemie", vol. 2, p. 255.

<sup>3</sup> *Rev. Tran. Chem.*, **35**, 1, 1915.

#### Hall Effect and Superconductivity.

THE Hall effect of the so-called electronic semiconductors is usually found to be comparatively very large. All the semiconductors investigated up to the present time obey this rule, with the exception of lead sulphide ( $\text{PbS}$ ), for which the experimental data vary from one sample to another. For example, according to van Aubel<sup>1</sup> and Heaps,<sup>2</sup> chemically pure lead sulphide has a very small Hall coefficient, while the Hall constant of the natural lead sulphide (galena) may (according to investigations by A. Smith<sup>3</sup> and Heaps<sup>2</sup>) reach values as large as 254.

We have studied the Hall effect of copper sulphide ( $\text{CuS}$ ) prepared by exposing a copper plate to sulphur vapour.<sup>4,5</sup> The Hall coefficient was found to be less than  $10^{-3} \text{ c.g.s. units}$ .

It is well known that copper and lead sulphides are semiconductors which belong to the class of superconductors. It was natural to consider the question whether the small values of the Hall coefficient may be related to the existence of superconductivity.

The experimental data on the Hall effect in superconductors seem to show that this correlation really

exists In the accompanying table, the experimental values of the Hall coefficient  $R$  for superconductors at room temperatures are recorded In the last column the products  $R\sigma$  (where  $\sigma$  is the conductivity at the same temperature) are given, the figures here are not very precise, because the corresponding quantities were not always measured on the same sample We include in this table similar data for a lead-bismuth alloy (20 per cent bismuth) investigated recently in this laboratory

|                                |                   | Transition point | $R \times 10^5$      | $R\sigma$ |
|--------------------------------|-------------------|------------------|----------------------|-----------|
| Metals super-conductors        | Hg (solid)        | 4.22             | <2                   | <1        |
|                                | Sn                | 3.71             | 2                    | 15.3      |
|                                | Pb                | 7.2              | 9                    | 4.5       |
|                                | In                | 3.37             | 7.3                  | 8.4       |
|                                | Tl                | 2.37             | 24                   | 13.6      |
|                                | Ta                | 4.4              | 100 (?)              | 60.0 (?)  |
| Metals non-super-conductors    | Na                |                  | 250                  | 550       |
|                                | Cu                |                  | 52                   | 320       |
|                                | Ag                |                  | 80                   | 536       |
|                                | Au                |                  | 70                   | 315       |
|                                | Mg                |                  | 90                   | 207       |
|                                | Zn                |                  | 104                  | 181       |
|                                | W                 |                  | 118                  | 225       |
| Superconductor                 | Pb-Bi (20% Bi)    |                  | <20                  | <5        |
| Compounds super-conductors     | CuS               | 1.6              | <100                 | <30       |
|                                | PbS               | 4.1              | 800                  | 8.5       |
| Compounds non-super-conductors | Mo <sub>2</sub> S |                  | $2.6 \times 10^8$    | 1400      |
|                                | Ag <sub>2</sub> S |                  | $0.6-50 \times 10^8$ | 50-275    |

As can be seen from these data, the superconductors show usually a relatively small value of  $R$  and especially of  $R\sigma$

We are investigating now the validity of this rule for other superconductors We reserve the discussion of the figures given in this note and the consideration of the theoretical conclusions which follow from this correlation for a detailed account which will be published soon in a new periodical entitled *The Physics of the Soviet Union*

We have to thank Dr. Dorfman for his helpful discussion of our work

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<sup>1</sup> *Phys. Zeit.*, 4, 551, 1913

<sup>2</sup> *Phil. Mag.*, 6, 1283, 1928

<sup>3</sup> *Phys. Rev.* (2), 1, 339, 1913

<sup>4</sup> Meissner, *Zeit. für Phys.*, 58, 570, 1930

<sup>5</sup> K. Fischbeck und O. Dörner, *Zeit. für anorg. und allg. Chemie*, 181, 372, 1929

#### Reactions of Horizons in Tropical Soils.

THE reactions of a large number of samples carefully taken at different depths in the profiles of red soils which cover such large areas of south-central Africa have been determined in this laboratory When the pH values of samples taken from a pit dug in undisturbed virgin soil are plotted against the depth, almost perfect curves are invariably obtained, there

being generally a depth of from two to three feet at which the maximum acidity is obtained This is generally coincident with the depth at which there is a tendency to form a pan both in lateritic, true red, and immature red loams, and also in the ferruginous red loams described by Marbut and Shantz In the latter soils, indeed, the pan is associated with definite concretions of hydrated sesquioxides

Further results with samples from older cultivated lands generally show the highest point of acidity to be much nearer the surface This is not surprising when the erosivity of red loam soils is considered and that often a quarter of an inch of soil has been removed in a

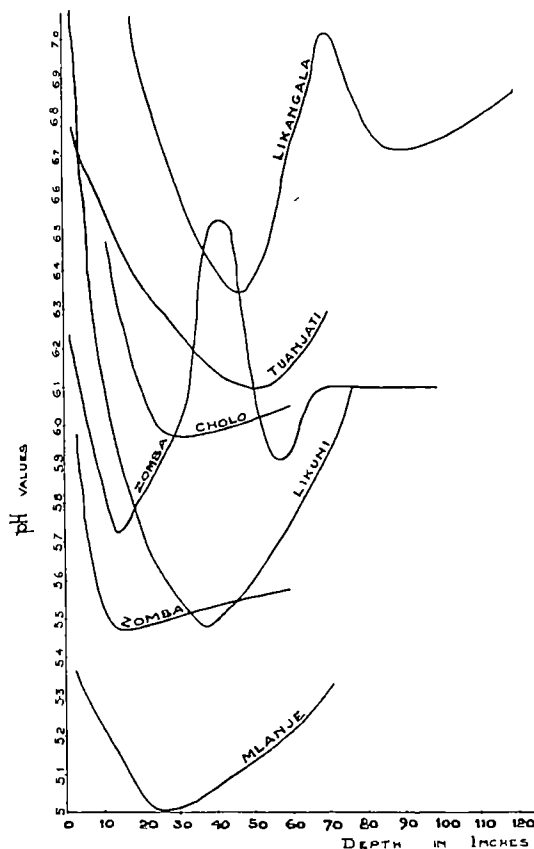


FIG 1

season by surface run-off and collected in large pits in Nyasaland

There has been found in these studies a general correlation between pH values and figures for average rainfall, the highest acidity being found in the tea belt of Mlanje

It has been further noticed in lower horizons of certain soils that a second point of maximum acidity is reached This may, however, be associated with abnormal movement of underground water during the wet season

It is suggested that these studies have a distinct bearing on the accumulation of compounds of iron, alumina, and manganese at certain horizons in tropical soils There are strong indications that iron bacteria play an important part in the movements of such compounds and in the formation of pans

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### Liquid Drops on the Same Liquid Surface.

DR. M. KATALINIĆ has described a method of producing floating drops of clean water on a water surface by delivery from a suitably situated jet.<sup>1</sup> Such drops must owe their existence to the stability of the film immediately beneath them, that is, the thickness-coefficient of the surface tension of the film over a suitable range must be negative, a characteristic of all stable films such as those of soap. Therefore a drop of soap solution should be stable on a water surface, the hydrophobic ends of the soap ions in the surface being directed outwards, and we were able last August to produce such drops of any diameter up to about 1 cm. by simply dipping a piece of soap (any kind) in water and allowing the drops to fall off it on to the surface from a height of about 1 cm. It is best to draw the soap down in a sweeping curve into the water and then out. In this way the floating drops are propelled forward and travel for distances up to quite 1 metre, if they are not too large. The very large drops last for scarcely one second, but the smaller ones for much longer. We experimented in a large tank of rain water illuminated by the sun, and interference colours were easily observed in the film beneath the drops. Later we obtained the same results in a beaker of distilled water, or even in tap water. The observations we made were, in the main, the same as those recorded by Dr. Katalinić.

Our main object in this communication, however, is to record an observation which to us is new, namely, that in addition to the floating drops, there are often produced, but in much smaller numbers, drops of about 1-4 mm diameter which sink to a considerable depth and slowly rise again, coming to rest immediately underneath the surface. The soap film surrounding these drops is evident by the interference colours observed. They are stable for at least a minute, although they immediately burst on being touched, for example, with a clean platinum wire. They occasionally contain a minute air bubble of about 0.1 mm diameter.

We are of the opinion that these submerged drops are formed by the drop of soap solution sinking into and getting encased entirely in the main bulk of the water, because occasionally, on slowly arriving upwards at the surface, they break through and eject their own contents some millimetres above the surface, in the form of a drop which bounces several times on the surface before coming to rest and ultimately coalescing. We recently found that these submerged drops are easiest obtained in tap water.

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ALUN R. HUGHES

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Dec 11

<sup>1</sup> NATURE, 127, 627, April 25, 1931

### A New Method of Investigating the Modes of Vibration of Quartz Crystals

A NEW method of investigating the modes of vibration of quartz crystals has arisen out of the use of E. P. Tawil's<sup>1</sup> development of Topler's *Schlieren* method. Tawil was able, by utilising variations of refractive index, to photograph stationary or progressive supersonic waves in air.

In this experiment, if an accurately worked quartz crystal is set up in the incident light-beam, it is possible to orientate the crystal so that the light transmitted through it is undeviated, consequently, if the crystal is not oscillating, the whole of the field will appear dark when viewed through the telescope.

As soon as the crystal is set oscillating it will be found that certain parts of the crystal will light up, leaving in most cases a pattern of dark bands. If a fundamental mode is used, the appearance of the system will be as shown in Fig 1, A, if a more complex vibration is obtained, a correspondingly complex pattern results, as shown in Fig 1, B.

It is clear that those parts remaining dark are not giving any deviation of the incident light, and consequently represent nodal lines. However, the interpretation of the results will be complicated by the



FIG 1

fact that the pattern is probably the mean result of all figures in all planes perpendicular to the light-beam.

The method appears to possess these advantages:

(1) The effect is easily obtained even with low intensities of oscillation.

(2) The result is readily photographed.

(3) The effect is one of black-and-white contrast and consequently stands out well in cases where a coloured field might confuse the result.

In short, it seems that this additional method of examining the modes of vibration of quartz plates will, when combined with a polarised light method, give very useful results.

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<sup>1</sup> *Comptes rendus*, 191, pp. 998-1000, 1930

### An Electrostatic Explanation of the Phenomenon of Flotation.

THE explanation of the flotation processes with the aid of the cataphoretic and electroendosmotic potentials has failed completely. These potentials play an important part at a distance from the geometrical interface of the phase only.<sup>1</sup> There are, however, suggestions in the literature<sup>2</sup> that ideal chemical electrodes should have a positive electrostatic potential in water and the dielectrics a negative one. This suggestion has important consequences. Emulsions of dielectrics in water will wet unattackable electrodes immersed in water but not attackable electrodes which are coated with dielectric oxides (hydroxides) in water. The wetting must, however, reduce the positive charge of the unattackable electrode, and it is expected that the wetting will not take place on attackable electrodes coated with a dielectric hydroxide, as for example, zinc. This is actually observed.

The irreversible electrostatic potential on the interface solid-liquid was measured with the aid of a Lindemann, or Leiss Perucca electrometer of small capacity. A platinum electrode, a galena electrode, an Acheson graphite electrode for spectroscopic purposes made by Messrs Adam Hilger, Ltd, and a zinc electrode, were immersed successively in 50 c.c. of 0.002 N potassium chloride of pH 7.5 and their potential was measured against a 0.002 N calomel

electrode Adding to the 50 c.c. of 0.002 N potassium chloride an emulsion of 4 gm. terpineol and 4 gm. potassium xantogenicum in 1000 c.c. of 0.002 N potassium chloride of the same pH, namely, 7.5, there was found a remarkable difference in the behaviour between the unattackable electrodes, platinum, galena, and graphite and the attackable zinc. Zinc changes its potential very little, the indifferent electrodes mentioned above, however, show a very marked fall of the potential as is shown in Fig. 1.

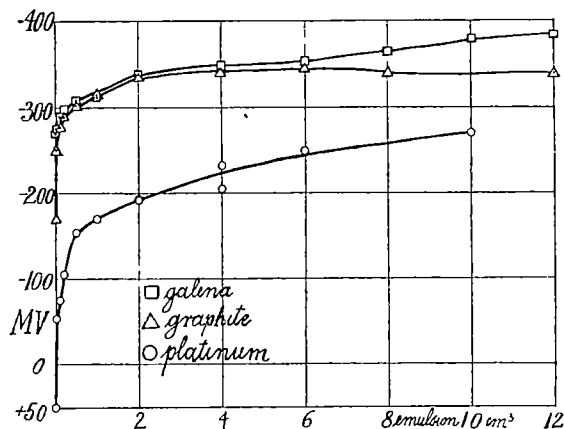


FIG. 1

The first portion of 0.02 c.c. of the terpineol and potassium xantogenicum emulsion has a great influence on the potential of the electrode in spite of the fact that the emulsion loses its character at that dilution, and at 1 c.c. of these weak solutions has a maximum effect. Solutions of that strength are used in practice for flotation most frequently. It should be added that the electrometric measuring of the hydrogen ion concentration of physiological yeasts may be entirely spoiled if such a minute concentration as 1 in 500,000 by weight of an organic compound changes the potential of platinum so markedly.

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Nov. 17

<sup>1</sup> Freundlich, H., Ettisch, G., *Zeit. für phys. Chem.*, **116**, 401-419 (1925).

<sup>2</sup> Kamiński, B., *Zeit. für phys. Chem.*, **138**, 345, 1928; **145**, 48, 1929; **147**, 288, 1930; *Przemysł chemiczny*, **201**, 1931.

### Nature of Liquids

PROF. G. W. STEWART<sup>1</sup> and Prof. E. N. da C. Andrade<sup>2</sup> have agreed, one in the light of X-ray diffraction experiments, and the other in the light of theoretical considerations of viscosity, that a liquid is, especially near the melting point, more akin to a solid than a gas.

It is perhaps worth while to point out that this view is consistent with what is observed concerning the specific heats of elements in the solid and liquid phases near the melting point. It is, in fact, the case that for the majority of monatomic elements hitherto investigated, the atomic heat of the liquid at constant volume is within about ten per cent of the value for the solid immediately below the melting point, and that this value is approximately  $3N_0k$  (that is,  $3R$ ), where  $N_0$  is Avogadro's number and  $k$  is Boltzmann's constant.

The value  $3R$  for the solid may be explained in terms of the three degrees of freedom of an atom, each degree of freedom contributing on the average  $\frac{1}{2}kT$  to the energy as kinetic energy, together with (if the

oscillation is simple harmonic in character) a further  $\frac{1}{2}kT$  as potential energy.

The fact that the variation of energy content with temperature in the liquid is approximately the same as in the solid, is consistent with the view that in a liquid, at temperatures not too far above its melting point, the atoms continue to execute motions which may be described as approximately simple harmonic, the contribution per degree of freedom of the potential energy to the total being still approximately equal to that of the kinetic energy, which, since it depends on squares of velocities, must have the equipartition value of  $\frac{1}{2}kT$ .

If, on the other hand, the potential energy of atomic motion in a liquid were negligible compared with the kinetic energy, the atomic heat at constant volume would fall to the value appropriate to a monatomic gas, namely,  $\frac{3}{2}R$ . L. G. CARPENTER

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Dec. 3

<sup>1</sup> NATURE, **128**, 727, Oct. 24, 1931.  
<sup>2</sup> NATURE, **128**, 835, Nov. 14, 1931.

### Freshwater Eels in British India.

FOR some ten years now I have been collecting data regarding the occurrence or absence of freshwater eels—of the genus *Anguilla*—in the fresh waters of the world, and we seem on the whole to have cleared up this matter. Yet there are two regions where some uncertainty still reigns and, curiously enough, British India is one of them.

I have seen specimens of freshwater eels from the greater part of India, from Burma to Bombay, but whether they occur north of Bombay, and especially in the River Indus, I have not succeeded in determining, neither through the available literature nor through questions. Yet it would be astonishing, it seems to me, if there were no information on this subject from one of the principal river systems of the Old World.

The question is of considerable importance for the understanding of the distribution of the freshwater eels, which spawn in the Indian Ocean. It would be of interest, therefore, if Indian zoologists, or others concerned with the fisheries there, could take up this question and discover whether freshwater eels of the genus *Anguilla* are really present or wanting in the River Indus.

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### The Raman Band of Water.

THE peculiar feature of the Raman band of water which I observed during my experimental researches<sup>1</sup> may be produced, or at least essentially modified, by a particular and unexpected action of the spectrograph.

The Hilger E1 spectrograph used by me being provided, immediately behind the slit, with a total-reflecting prism of crystalline quartz, that is, with a double-refracting system, we are making use of an optical arrangement that may cause interferential phenomena, if the incident light is even partially polarised.

Under such conditions the use of the above-mentioned spectrograph is inadvisable. G. BOLLA

Physical Institute of the Royal University,  
Milan, Dec. 10

<sup>1</sup> NATURE, Sept. 26, 1931.



## Research Items.

**Prehistoric Sind and Sumeria**—Mr Ernest Mackay publishes in *Antiquity* for December some further links between Mohenjo-daro and ancient Sumeria, which he is able to add to those given in the recently published "Mohenjo-daro", edited by Sir John Marshall, as a result of the examination of material added to the Baghdad Museum since he left Iraq. Red carnelian beads with a white design found in graves at Ur are identical with those from Sind, the latter probably being a local copy of an imported head. Other examples of decorated carnelian beads link the two civilisations, but at Mohenjo-daro they were probably imported and were greatly valued, as is shown by the fact that they were copied in steatite, the red ground being produced by a burnished hæmatite paint. Persia may have been the original source and may also have supplied Russia. A peculiar bead, rhomboidal in section, of which the long sides are notched, is also found at Ur and Kish, where it is dated at about 3100 B.C. They may be copied from sickle flints, and in Sind were probably imported from Sumeria. Terminals in gold, copper, or faience are frequently found at Mohenjo-daro. Though not yet found in Sumeria, they occur at Byblos, dating from the Fourth Dynasty of Egypt. Hollow gold terminals exactly resembling these have recently been found at Gizeh (2900-2750 B.C.). A copper blade found at Mohenjo-daro in one of the upper layers exactly resembles one from Kish, except that the latter has a longer tang. Cubical dice, tetrahedral gamesmen, and pottery rings, thought to belong to a game, have been found at Mohenjo-daro and in Sumeria. The framed Greek cross and the swastika occur in both areas, though a swastika found at Kish may have been made locally for an Indian resident. Other resemblances noted are feeding-cups with projecting spouts, beads capped with gold, perforated vessels, hollow animal masks in pottery and metal, and the narrowing of the eyes in certain human figures.

**Rhythmisation in a Motor Task**—At the meeting of the British Association on Sept. 28 a very interesting paper was given to Section J (Psychology), by Mr D. W. Harding, on the part played by rhythm in learning typewriting. Observations were made on experienced typists practising an unfamiliar word until they could type it at their normal high speed. In typing, owing to the nature of the keyboard, the rhythms that may occur are more complex than those hitherto studied in G. E. Muller's experiments in memorising. The experiments were carried out with an ordinary portable typewriter, but in place of the usual paper for receiving the impressions, a paper tape moving through the machine at a constant rate was substituted. The subjects typed in the usual way, but, as the tape moved continuously, any difference in the time intervals between letter-strokes was recorded as a difference in spacing on the tape. Each subject's work was measured for uniformity by estimating the deviation from uniformity of the time-interval between each letter-stroke and the next, and for consistency, as represented by the coefficient of variability, from repetition to repetition of the ratios in the word. This allowed the sameness of the rhythm to be measured even though the tempo might not be the same. The most striking result that appeared was the relation between rhythmisation and capacity for speed, those subjects who tended to maintain uniform time-intervals between successive letters being the slowest. As the learning of movements plays such an important part in education and also in many

industrial processes, this very careful and original study is of considerable value and deserves to be carried further.

**Sexual Selection and External Appearance**—O. L. Tinklepaugh, in the *Journal of Mammalogy* for November (p. 430), records a case in which a male of the rhesus macaque (*Macaca mulatta*), kept along with a female crab-eating macaque (*M. irus*), plucked and bit off the long hairs of the eyebrows and cheek-tufts of his companion, often leaning back and surveying her as if evaluating results. The suggestion is made that he was modifying her appearance to suit his taste, and it may be noted that the rhesus is far less hairy about the face than the crab-eating macaque, so that it would appear that the male was here trying to make his alien mate conform to the appearance of females of his own species. A similar case in birds occurred at the London Zoological Gardens during this century, in which a male ocellated turkey (*Meleagris ocellata*) plucked out the crest of a Burmese peahen (*Pavo muticus*) which had become attached to him in spite of the presence of a male of her own kind, thus reducing her head to the unadorned state of that of a hen turkey.

**Abnormalities in the Frog's Blood-vessels**—Dr C. H. O'Donoghue (*Trans. Roy. Soc. Edin.*, vol. 57, pp. 179-224, 1931) describes forty-eight hitherto unrecorded abnormalities in the blood vascular system of *Rana temporaria*, summarises the abnormalities previously recorded, and discusses the general significance of each type of abnormality. One example of an imperfectly flexed heart is described, which, it is suggested, results from the retention of the dorsal mesocardium. In one frog the right systemic aorta was absent, posterior to the point of origin of the subclavian artery, in four other frogs accessory pulmonary arteries were present as branches of the coeliac-mesenteric artery to one or both of the lungs. In each of nine examples a transverse anastomosis was present between the two external jugular veins, and in the majority of these the right anterior caval vein was missing. Six abnormalities of the anterior abdominal vein and seventeen abnormalities in the posterior cardinal, posterior caval, and renal-portal veins are noticed, which are explicable in the light of the embryonic history of the respective veins. Abnormal accessory pulmonary veins arising in the lungs and emptying into some factor of the hepatic portal system are described in six specimens. A consideration of some of the abnormalities reveals homologies between certain of the main veins in the Anura and in the elasmobranchs. This paper will be very useful for reference in all laboratories where the blood vessels of *Rana temporaria* are examined in any detail and where, therefore, abnormalities are almost certain to come under observation.

**Indian Horse Flies**—Part 3, Vol. 1 (September 1931), of the new *Indian Journal of Veterinary Science and Animal Husbandry*, among other articles, contains part 14 of a "Veterinary Entomology for India", by T. B. Fletcher and S. K. Sen. It deals with the Tabanidæ or horse flies, of which about 135 Indian species have been described. The article is illustrated with an admirable coloured plate depicting twenty-four species of various genera. One of the most remarkable insects figured is *Corizoneura longirostris*, in which the 'proboscis' is one and a half times the length of the body. This fly has been observed to suck nectar from flowers, and the long

proboscis, which is actually the labium, is well adapted for scooping up nectar. The true piercing stylets are much shorter and are hidden away in the labium.

**Cultivation of Sisal**—Sisal (*Agave sisalana*) is a fibre-yielding plant of great and increasing importance in East Africa, and some account of the problems in connexion with its cultivation are given by F. J. Nutman of the Amani Research Station (*Bulletin of the Imperial Institute*, vol. 29, p. 299). Up to the present, scarcely any research has been carried out with this crop, as it has been possible to grow it profitably with a minimum of scientific knowledge, and since the plant is not an annual, field experiments are necessarily long and expensive. One of the most important physiological questions is a proper understanding of the factors influencing flowering, for after the production of the inflorescence the plant dies and no more leaves, the source of the fibre, are developed. The suggestion that flowering, or 'poling' as it is termed, occurs after the formation of a given number of leaves is rejected, but it is still uncertain whether, and in what way, soil, climate, and water relations can be correlated with this fundamental change in the plant's development. Fruiting, on the other hand, appears to be influenced by quite different factors, for although flowering is a universal phenomenon, fruit formation is confined to the highlands of Kenya. Propagation is in consequence entirely vegetative by means of bulbils and suckers, and further investigations are needed to determine if treatment of the parent can influence the after behaviour of the suckers. Other important problems arise in connexion with the drought-resisting properties exhibited by sisal, for there is a tendency to extend its culture into the more arid parts of East Africa, and under semi-desert conditions special cultivation operations appear to be necessary. In addition to physiological problems such as these, questions of agronomy and genetical interest abound, and if the sisal industry is to survive the critical period through which it is at present passing, further research is of fundamental importance.

**Origin of Witwatersrand Gold.**—Dr L. C. Graton's recent advocacy of a hydrothermal origin for the gold deposits of the Rand has stimulated a vigorous discussion, which is published in an 'Annexure' to the *Trans. Geol. Soc. South Africa*, for 1931. In all ten papers the conclusion is reached that the hydrothermal hypothesis is untenable. R. B. Young shows clearly that the distribution of gold is related to the sedimentary characters of the beds, whereas the metasomatism that has undoubtedly occurred bears no relation to that distribution. This contrast is confirmed by E. Homersham, E. T. Mellor, and J. W. Gregory. The last two of these authors and A. W. Rogers, F. E. Keep, E. H. A. Joseph, and W. S. F. Cameron give conclusive evidence that the blanket could not have been accumulated in the off-shore marine environment postulated by Graton; they favour deltaic or littoral conditions, and record many instances of contemporaneous erosion. F. E. Keep makes a good point in comparing the gold occurrences with those of genuine hydrothermal origin. E. T. Mellor, E. P. Cowles, and P. Macadam present assay results demonstrating that the amount of gold carried by the quartz veins is negligible compared with that in the pay reefs. P. Macadam also shows that the basic dykes are free from gold or contain only minute traces, and W. S. F. Cameron considers, with justification, that the gold in the quartz-veins may well have been derived from that present in the placer deposits through which they have passed. (See also *NATURE*, 127, 536, April 4, 1931.)

**Acoustic Sounding**—Commander J. A. Slee read an important paper on reflexion methods of measuring the depth of the sea to the Institution of Electrical Engineers on Dec. 2. Navigators of big ships are very anxious to read depths up to a hundred fathoms and are particularly interested in depths from two to twenty fathoms of water under the keel. Trawlers, on the other hand, need to measure much greater depths, at least as great as 350 fathoms. The vast majority of fish are bottom feeders—the surface and midwater feeders are comparatively rare. For a given locality and time of year, the best depths for various kinds of fish are known, and so it is a great boon for the fishermen to know the depth within an accuracy of about one or two per cent. The author describes the various methods of signalling, that is, of setting up an elastic wave in the water, the methods of detecting the return of the echo, the methods of disentangling the unwanted signals, and the methods of measuring the time which gives the required depth. The rate of propagation of the elastic wave varies according to the salinity and temperature of the water, the accepted extremes being 4750 ft. per second for the Baltic, which is nearly fresh, and 5100 ft. per second for the Red Sea, which is saturated. The velocity usually adopted is the average of the Atlantic Ocean, which is 4900 ft. per second. The best methods of measuring are to use some form of oscillographic device. Aural methods are not so successful, as the rush of water past the ship's skin sets up noises in any kind of receiver and, in addition, there is the question of turbulence eddies. The water is thrown out by the ship's bows and returns again at some point along her hull, where the water noises are redoubled. It is known that the position of these turbulence areas varies with the speed of the ship, with her draught and trim, but in any given case the boundaries of the patches are quite sharply defined.

**The Spin of the Photon**—The work referred to by Sir C. V. Raman and S. Bhagavantam in their recent communications to *NATURE* (Oct. 3, p. 576, Oct. 24, p. 727), from which it was concluded that light quanta had a Bohr unit of angular momentum, is described with more detail in the issue of the *Indian Journal of Physics* for Oct. 31. It appears that up to a certain point quantum theory and classical theory agree in their predictions with regard to the scattering of light, but that the finer details of polarisation and intensity can only be accounted for by means of quantum theory, with the special feature now emphasised. The experimental method which has been employed is simple in principle, the separation of the effects of the various close components of the radiation scattered from gases and liquids being made by varying the width of the slit of the spectroscope (see *NATURE*, Jan. 2, p. 22). The references in this paper to liquids, although not an obvious sequel to Sir C. V. Raman's later letter (*NATURE*, Nov. 7, p. 795), are very interesting in showing that molecules in certain types of liquids apparently have considerable rotational freedom. At the same time, in another paper in the same issue of the *Journal*, Mr. Bhagavantam has shown that the rotational fine structure of the Raman bands from a number of gases becomes diffuse above a certain rather critical pressure in each gas, and interprets this as a disturbance of the molecular spin by collisions when the frequency of rotational motion of a molecule is no longer greater than the average frequency of collisions between molecules.

**Conical Diaphragms and Sound Reproduction**—The scientific aspect of the problem of sound reproduction by means of conical diaphragms is one of commercial importance at the present time. In the *Philosophical*

*Magazine* for October, Dr N W McLachlan and G A V Sowter give the results of a fairly complete experimental research on this type of apparatus for reproducing speech and music. They have found that when the edge of a diaphragm is reinforced so as to prevent radial modes of vibration at low frequencies, the lower register appears to be missing. This is due to the enhanced output in the upper register. Thus, although the diaphragm behaves as a rigid structure at low frequencies, it breaks up at the higher frequencies. To equalise the output, therefore, it is necessary to introduce a resonant member to assist the lower register. One method of doing this is to suspend the diaphragm from an annulus of suitable material and dimensions. The annulus acts as an auxiliary diaphragm at low frequencies and improves the reproduction. The upper register can be increased by the use of coils of small mass. This suggested the use of thin sheet metal, but experiments with aluminium sheet were not successful, as a large fraction of the register lying above 200 cycles per second was relatively weak. The reproduction lacked volume and was unpleasant to listen to. This shows the difficulty in obtaining a uniform register of wide compass owing to the load on the acoustic system being small and the acoustic resonances being numerous. In the exponential horn type the acoustic loading is relatively high and gives large damping. The horn is a scientific but not at the moment an economical solution of the problem of sound reproduction.

**Rhenium Compounds**—Briscoe, Robinson, and Stoddart, in the November *Journal of the Chemical Society*, give details of some experiments on the sup-

posed thallous thioper-rhenate,  $\text{TLReS}_4$ , recently described by Feit. They show that the product so described is not a thioper-rhenate but either a mixture of thallous per-rhenate and rhenium sulphide, or almost pure per-rhenate, according to the method of preparation. The same issue gives an account, by Briscoe, Robinson, and Rudge, of a new oxide of rhenium, the pentoxide,  $\text{Re}_2\text{O}_5$ , obtained by heating rhenium heptoxide with the metal in a sealed tube. It is a purplish-red crystalline powder, being bottle-green in thin flakes with transmitted light and showing a green streak. The new oxide is insoluble in dilute or concentrated sulphuric or hydrochloric acid and in caustic potash solution, but dissolves in warm dilute nitric acid and in fused caustic potash.

**The Glass Electrode**—The *Journal of the Chemical Society* for November contains two papers by C Morton on the use of valve electrometers and valve potentiometers with the glass electrode. The arrangements of the circuits are shown and the accuracy of the instruments has been increased. The application of the valve potentiometer to differential potentiometric titration with the glass electrode is described, with some experimental details. The new feature of the valve potentiometer is an increase of sensitivity with increasing resistance of the source of electromotive force, which makes it particularly suitable for use with the glass electrode. A sensitivity of 38 microamperes per millivolt was obtained. The null ballistic valve galvanometer described had complete zero stability and high sensitivity. The sensitivity was such that an electromotive force of 0.01 millivolt operating through 1000 megohms could be detected.

### Astronomical Topics.

**Great Meteor in Southern Europe**—The daily papers reported that a meteor of unusual size was seen in Portugal on the night between Dec 28 and 29. No exact details are yet to hand, the reports describe it as greenish, three times the apparent diameter of the moon, and suggest that it may have fallen into the sea, as its light vanished with startling suddenness. It is to be hoped that it was seen by some trained observers.

**Observations of the Leonids in England**—The fact that a fair display of these meteors was seen in England by Mr J P M Prentice at Stowmarket, Suffolk, and Mr A King at Ashby, Lincs, has been already noted in this column. Fuller details are given by Mr King in the *Observatory* for December. The maximum, according to both observers, occurred rather late on the night between Nov 16 and 17. None were seen on Nov 9 and 11, one early on Nov 14, while Mr King saw eight early on Nov 18, a fair shower was seen in Iowa early on Nov 16, so that the earth takes more than two days in traversing a tolerably rich region of the swarm, though it takes only six hours in crossing the extremely crowded 'orthostream'.

The position of the radiant for the night Nov 16-17 is given as R.A. 153° 0', Decl. +21° 7', by Mr Prentice and R.A. 152°, Decl. +22° 2', by Mr King. Prof J C Adams adopted 149° 2' +23° 0' (the mean of six observers) for the 1866 display. Precession accounts for a change of +0° 9', -0° 3', the remainder is due to the perturbations of the meteors. The longitude of their ascending node, given by the above observations, is near 233° 9', which agrees exactly with the value of the node of Tempel's comet predicted in the B.A.A. Handbook for 1932.

**Cepheids and Long-Period Variable Stars**—*Scientia* for December contains an article on these stars by Mr P Doig. The two classes differ chiefly in temperature, the red stars of long period have temperatures of the order of 2000°, while the Cepheids range from 4000° (type G) to 10,000° (type A). The extreme rarity of these stars in space is pointed out; one star in a hundred thousand is a long-period variable, and the distances between them are of the order of 500 light years. The Cepheids are rarer still, accepting Shapley's distances (which are now thought to be somewhat too large), there is only one Cepheid in two million stars, and the distance between them averages 1500 light years. These figures suggest that variation of either kind lasts only for a small fraction of the whole life of a star.

Mr Doig considers that the ordinary long-period stars vary from a similar cause to the Cepheid stars, but that the super-giant Betelgeux stands outside them, probably because of its excessively low density. He favours the theory of Sir James Jeans that the Cepheids are rotating stars on the point of dividing into two. This causes a wave to travel round the star's surface, and its shape is supposed to be steeper in front than in the rear, thus accounting for the steeper rise than fall in the light curve. The long-period stars are supposed to be at an earlier and less condensed stage than the Cepheids, in both of them a liquid or quasi-liquid core is postulated. It is suggested that in Betelgeux the density may be too low for the formation of such a core. In its case the variation arises from pulsation alone, in the other cases from a combination of pulsation with the phenomena arising from an elongated nucleus in the process of dividing.

### University of Leeds. New Physics Building.

THE new physics building of the University of Leeds represents part of the rebuilding scheme made possible by generous donations from the public during the past several years. It replaces the old 'sheds', a temporary glass-roofed structure put up some twenty years ago, and part of one of the original wings in the occupation of the Department of Physics, but under the new scheme destined for demolition. These old laboratories had long been inadequate for their purpose and more than uncomfortable in use. The lecture room accommodation was scanty, the teaching laboratories weather-swept, and the research rooms unfortunately placed.

The new building occupies a quiet and unobtrusive site which is likely to be detached for some time to come, though it will eventually form architecturally an end link of the projected chain of stone-fronted buildings of which the chemical building and the Brotherton Library will shortly be prominent features. The cost of the physics building itself with equipment will approximate to £60,000. The architects were Lancaster, Lucas, and Lodge, of London.

So far as present needs are concerned, the Department caters for two hundred and fifty to three hundred undergraduates, including a total honours school of thirty to forty, with a research group of ten to fifteen working mostly on experimental topics. Allowing for expansion of these numbers on a conservative basis, a building of red brick, of about 35,000 square feet floor space, has been put up, comprising three floors and basement. Portland stone facing is used only on that small part which will be visible in the distance from the main road. The steel framework is specially oversize, and particular care has been taken that no internal walls support any appreciable part of the weight. Inside rearrangement can therefore be carried out in the future, if necessary, with no serious difficulty.

The workshop has been placed in a far corner of the basement, lit by an overhead glass roof and ventilated by a fan. The basement also contains certain research rooms, battery and store rooms, a special instrument test room, an acoustics laboratory, and a museum.

The entrance hall on the ground floor has been arranged to lead directly to the two main lecture rooms on one side and to the elementary laboratory on the other. This arrangement makes it unnecessary for the large numbers of students attending elementary lectures and laboratories to penetrate more than a few paces into the building, thus minimising the effects of wear, dirt, and noise.

The first floor carries a large L-shaped laboratory capable of accommodating a hundred students of the second and third year in individual work. On this floor there is also the honours laboratory with a capacity of about twenty students and a small lecture room capable of holding fifty.

The top floor contains a few rooms at the stair-head for general departmental use, the main floor space being given over to small research rooms, seventeen in number. In addition to the electrical and other services, a certain number of steady wall-supports consisting of monoliths built into the wall have been provided. Also horizontal sliding steel window shutters have been installed, similar to those in the lecture rooms but hand operated.

The simplest possible internal style has been adopted throughout the building, although a most pleasing effect has been attained in entrance, stairway, and corridors by clever arrangement of pillars, well-designed balustrades, and simple arches. The

stairways and the floors of main corridors are in terrazzo but elsewhere Australian jarroo wood block has been generally chosen, the result being excellent in respect of cleanliness and comfort as well as appearance.

For convenience of upkeep and ease of replacement, all services have been placed so far as possible on wall and ceiling surfaces and have been coloured distinctively. For example, lighting electricity is yellow, town supply of water is aluminium, gas is black, and so on. Electrical services comprise 200 volts alternating supply at 50 cycles single phase and two-phase from the city mains for lighting and power, together with 110 volts d.c. from a generator set in the basement. In addition, there are two large capacity batteries each giving up to 120 volts and two smaller ones giving up to 1000 volts each. These supplies are taken to the lecture rooms and to the research rooms on both top floor and basement. For convenience in running temporary leads about the building, a vertical duct runs through the building in close proximity to the battery rooms. A small compressor in the basement supplies compressed air to research rooms and lecture rooms for blowpipes, small motors, cooling, and the like. Heating throughout the building is by radiators supplied with hot water from the University boiler house. A lift and the adequately equipped workshop complete the laboratory services.

There are three lecture rooms, seating 230, 120, and 50 respectively, the two larger ones being fitted with electrically operated steel window shutters of a simple type. Ventilation is by distant-control fan, and the fittings include specially designed roller blind blackboards, air-cooled projection lanterns sunk in the lecture tables, with inclined screens built permanently into the wall and facing the audience, floodlights (motor head lamps) for blackboards and lecture tables, and an adequate supply of electricity, gas, water, and compressed air. The control of all lecture room services has been centralised on the lecture bench itself, so that the lecturer or his assistant can deal on the spot with lantern, ventilation, shutters, and lighting.

In the teaching laboratories, simplicity of arrangement and fittings has been achieved by the provision of ordinary movable tables of a standard size, and fixing all water services to outside walls wherever possible.

In place of dark rooms for optical and other experiments requiring darkness, several sets of dark cells have been provided (similar to horse 'loose boxes'), so that numbers of students can work in close proximity to each other without mutual interference. In the main laboratories, vibration-free supports for galvanometers and other apparatus requiring steadiness have been provided by casting wide ferroconcrete collars round such pillars as have their foundations in the basement. Round these collars are fitted insulated stainless steel busbars connected to 25 volts alternating electric supply. This supply is taken through a new type of electric plug which adheres to the busbars by means of small permanent magnet contacts.

Although, at the date of writing, workmen are not yet out of the building, experience has shown the great convenience and effectiveness of the arrangements.

An opening function will take place on Feb. 18, when Sir William Bragg, one time occupant of the Cavendish chair of physics in the University, will be the principal speaker.

## Annual Meeting of the Science Masters' Association

THE thirty-second annual meeting of the Science Masters' Association was held in the Imperial College of Science, London, on Dec 29-Jan 1, with evening meetings in the hall of King's College for Household and Social Science. The trade exhibition of apparatus and books, and also the exhibition of apparatus and experiments by the members themselves, was the largest in the history of the Association.

In the course of his presidential address, Dr Cyril Norwood, headmaster of Harrow School, pointed out that modern science has produced an upheaval in man's intellectual and spiritual outlook comparable to that produced by the Renaissance, and, in its material aspects, has led to a rapidly increasing mechanisation of modern life. The one effective shield against this mechanisation will be found in a remodelling of our system of education, so that it will satisfy the creative instinct of the child to do and to make, and also develop his faculty of æsthetic appreciation.

The Renaissance produced a system of education, culminating in the universities, which has persisted until recently, despite the fact that only one-tenth of the secondary school population now proceeds to the universities. The object of the older type of education was to produce specialists and to train for the professions, but in future the schools must aim at becoming training grounds for democracy. Whereas in the past the schools produced the great individual, they must now aim at the wider task of producing the great community, and our educational system must be remodelled to that end. This requires the freeing of the school certificate from the demands of university entrance.

An elementary study of any subject should result, in average pupils, in the acquirement of a sense of fact and a sense of law. Dr Norwood stated that there is nothing better for this purpose than the study of elementary science, which is admirable for training the mind in the power of discovering facts and reasoning from them, and, properly taught, should result in a clear grasp of the difference between fact and opinion, which difference, even as in Plato's time, is not apparent to the majority of people. Dr Norwood recommended the *universal* teaching of science as a necessary part of a preparation for citizenship. He suggested a course in chemistry, physics, and biology, with excursions into geography, geology, and astronomy, which should include simple elementary nature study and exact and simple measurement. Such a course would open a lot of windows in the mind of the pupil.

In welcoming the Association to the Imperial College, the rector, Mr H. T. Tizard, stated that the scientific equipment and also the general education of boys has improved beyond all bounds during the last few years. This period has seen the disappearance of both the dogmatism of the scientific man and the arrogance of the classicist. Mr Tizard is a great believer in general science as a subject for the school curriculum. The difficulty is that scientific men have not yet been able to agree upon the lines this should take, and he urged that the solution of this problem should be the most important work of the Association in the near future. He hoped that they would produce a scheme which would appeal to intelligent laymen.

Prof Jocelyn Thorpe, in his address on "The Schools and Research", directed attention to the great work which has been accomplished by such men as Shenstone, H. B. Baker, Francis Jones, R. L.

Taylor, and Tilden, all of whom commenced their researches as science masters in schools. If a science master can find time to do research in his school, it is bound to have a stimulating effect on his pupils. He invited attention specially to the advances made in biochemistry during the last few years, which have resulted in the isolation of definite organic compounds controlling the processes of life. Some of these are introduced into the body by the food we eat, others are manufactured in the body itself, but all are essential to life and health. Sometime in the future, much ill-health and disease will be eliminated by the administration of the required organic substance in the quantity necessary to correct the maladjustment. Prof Thorpe went on to discuss the importance of hormones and vitamins, and he showed specimens of the anti-scorbutic vitamin E, which has only recently been isolated from orange juice. Calciferol (vitamin D) has also been isolated after twelve years of patient research.

Dr G. C. Simpson addressed the Association on "Modern Weather Forecasting", in the course of which he gave a most lucid account of the mechanism which produces a 'warm front' and a 'cold front'.

On New Year's eve, Prof E. W. MacBride's lecture on "The Inheritance of Acquired Characters" provoked a stimulating discussion, which was continued in the Common Room, until the approach of midnight reminded Prof MacBride that he had promised to attend a New Year party.

The Television Society arranged a most valuable lecture-demonstration, in which experiments, many suitable for school use, were shown. Mr J. J. Denton, honorary secretary of the Television Society, lectured, and the experiments were shown by Capt R. Wilson, Mr A. A. Waters, and Mr R. W. Corkling.

In the trade exhibition, the exhibit of colour photography, given by the Finlay Photographic Processes, Ltd., is worthy of special notice. The most interesting feature illustrated the application of the Finlay colour process in the teaching of biology. Eighty-one lantern slides were exhibited to illustrate a first year's course in biology, the zoological subjects having been selected by Prof E. W. MacBride, and the botanical subjects by Mr J. S. Gilmour, assistant director at the Royal Botanic Gardens, Kew. Many of the slides are micrographic, the colour is remarkably accurate, and there is no doubt that the utility of these slides for teaching purposes is greatly enhanced by their being in colour. We understand that if the company meets with sufficient encouragement in its effort to furnish accurate colour slides of this description, a further series of scientific subjects will be prepared. The process itself is one that can be worked quite easily by the amateur with any size and make of plate camera. Apart from the fact that it is an entirely British process, it has certain definite advantages over any other known method of colour photography. It gives a brilliant result with a single exposure at a very high speed, and it is capable of unlimited duplication. Many of the outdoor scenes shown were taken with an aperture of 4.5 at speeds which varied from one-fiftieth to one-half of a second. It can be applied, therefore, to subjects involving movement or stay of movement.

In the members' exhibition, Mr E. G. Savage gave fascinating demonstrations of experiments on colour. These were described in detail in the *School Science Review* for October and December 1931. Mr F. A. Meier, of Rugby School, exhibited a remarkable selection of apparatus made in the Rugby School

workshops His ingenious devices are worth an article in themselves We were greatly impressed by his method of doing Kundt's experiment, using a brass tube with two thick circular plates of brass soldered at nodes a quarter of the length of the tube from each end, these plates fit between two blocks of wood on a rigid stand The cork at one end of the brass tube is stuck on by resin, so as not to constrain the vibration of the tube, and the resonance tube of glass contains no visible lycopodium until the note is obtained, when the nodes are evident as very fine lines, the position of which can be read to 0.02 cm. by a travelling microscope Mr Meier said that a few

degrees difference in temperature, such as results from turning out a gas fire in the room produces a measurable displacement of the nodes

The retiring chairman of the Association, Mr W H Barrett, of Harrow School, handled the annual business meeting with skill A resolution was passed assuring the president that the Association would support him in any steps he may take to initiate a reform of our educational system on the lines laid down in the course of his presidential address

The next meeting of the Association is to be held at the University of Bristol, on Jan 3-5, 1933, and the new president will be Prof A M Tyndall E N

### Form and Height of Clouds

THE Central Meteorological Observatory at Tokyo has recently published an illustrated account of a thorough photometric study of clouds made at the Meteorological Observatory at Mera Mera lies at the southern extremity of the Bôso peninsula, in the south-east of Japan proper, at no great distance from Tokyo The observations cover the period of two years ending on Mar 31, 1929, and were made by three members of the staff of the Mera Observatory

Although the work does not appear to have been undertaken with the solution of any particular problem in view, and might be adversely criticised on the ground that we have already too many such bulky statistical compilations relating to the weather of temperate latitudes, such criticism should be qualified in view of the fact that the information about the heights of various forms of cloud in this work is rarely based on measurements of single points in the cloud, but on so many points that an idea is given of the vertical extent of the cloud as well as of its height above the ground For example, a photograph numbered 217 in the section devoted to stratocumulus clouds, portrays a group of these clouds and alongside a key diagram with numbered points In a table underneath, the measured heights of these points are shown One of the larger fragments of cloud contains five such points, and the table shows that the lowest height was 1489 metres and the highest 1587 metres, whence we deduce a minimum of 89 metres for the vertical extent of this particular cloud The table further informs us that the mean height of the whole group was 1534 metres and the range 117 metres

The heights were obtained by two photo-theodolites of German manufacture set up at the ends of a base line 1161 metres in length—a length that should ensure a fair degree of accuracy even in the measurement of cirrus clouds, which normally occur at heights equal to about seven times the length of the base line

There is another aspect of the work which calls for favourable criticism, and that is that the quality of the photographs and the complete range of form illustrated justifies the authors in describing section VIII as a "Cloud Atlas" It is an atlas in which the full information about the heights of the clouds just described is supplemented by figures giving the mean amount of cloud on each occasion, its speed and direction of movement, and the speed and direction of the wind near the ground When telephotographic representations of cloud are given and no terrestrial object appears in the field of view, the reader is likely to have a difficulty in imagining the true appearance of the clouds, unless some device is adopted for giving the scale of the photograph In this event, a circular line might with advantage have been added in one corner of each photograph, the diameter of the circle being equivalent to about half a degree, that is, to about the diameter of the sun or moon, so that the clouds could be compared with either of these luminaries

It should be noted that in addition to the section described as a cloud atlas, there are numerous tables relating to the heights of the different clouds, and the seasonal variations of these are shown by graphs, as well as being given in tabular form

E V N

### Photocells: the Valves which operate by Light.\*

ONCE the potentialities of devices in which the action of light produces or changes the magnitude of an electric current are properly appreciated, they are likely to become very widely employed At least four types of these are now available—the selenium cell and its congeners, the alkali metal cell—operating on the external photoelectric effect, and often called a photoelectric cell to the exclusion of the others—the electrolytic cell, and the dry plate rectifier cell Of these, the electrolytic cell, in which the electromotive force is changed when the electrodes are exposed to light, is as yet little understood, although it is likely to be of value for some purposes More attention is being paid to the rectifier cell, which is the development of a crystal rectifier which has been found recently to be sensitive to light and is going to be very important Selenium cells employ a half

conductor of a similar type to the crystal, but work simply by its change in resistance when illuminated, Ohm's law being obeyed, which is not true of rectifiers

Choice of cell for any particular purpose depends upon exactly what is required of it, but the answer that an engineer wants in most of the less complicated industrial applications can be illustrated by performing an experiment, in which the current through an incandescent lamp is altered until it produces a current of a few microamperes in the circuits of various cells exposed to its light Selenium cells are found in this way to be the most sensitive, then electrolytic cells, gas-filled alkali cells, and rectifier cells, and the vacuum alkali cells come last On the other hand, vacuum alkali cells give a response proportional to the intensity of the light, provided its colour is not altered, and have the great advantage of having an effectively instantaneous response, whereas the response of the selenium cells bears a less simple relation to the intensity of the light and may not reach a

\* Substance of a lecture-demonstration given by Mr C C Paterson on Jan 5 at the Physical and Optical Societies' Annual Exhibition of Scientific Instruments and Apparatus at the Imperial College of Science, South Kensington



steady state for several seconds. Again, the selenium cell is most sensitive to red light and the potassium vacuum cell to green light, although to a green which is well to the short wave-length side of the region of maximum visual acuity. With a vacuum cell in which the sensitive cathode is a very thin film of caesium on a base of caesium oxide the maximum is in the infra-red. No one of these cells agrees with the eye about colour in giving a maximum in the yellow which appears brightest to the eye.

The different sensitivity of different alkali cells to light of different colours is applied in modern lamp photometry to determine accurately whether the light from two incandescent lamps is of the same colour, and therefore whether the two filaments are at the same temperature, on the principle that if two cells of different colour sensitivity are adjusted to give the same current when exposed to light of some definite colour, they will give the same current when similarly exposed to light of the same colour even if its intensity is different, but will not give the same current if the colour is different.

Amongst the laboratory uses of photoelectric cells may be mentioned the demonstration by one of the modern forms, that photoelectric emission is independent of temperature whereas thermionic emission is not. This has already been accomplished in several ways, but can be shown rather prettily with a caesium cell, which has a readily measured thermionic current below 200° C. One of these cells is mounted in a small oven and the thermionic current from it (if any) found by the ordinary direct method, whilst light which produces a photoelectric current too small to deflect the thermionic galvanometer is allowed to fall on the cell simultaneously and is rendered intermittent by passing it through a rotating disc. The photoelectric current through the cell is then also intermittent and may be amplified independently of the thermionic current and fed to a loud speaker, the sound from which is a measure of its magnitude. When the cell is cold there is a photoelectric current but no thermionic emission, but, when the oven is heated, a thermionic current develops rapidly, whilst the sound from the loud speaker, and hence the photoelectric current, is not appreciably changed.

### Physiological Basis of Sensation.

IF we are to regard a sensation as a change in consciousness in response to a stimulus applied to a sense-organ, then the sensation evoked by a given stimulus will depend on the complexity of the consciousness of the particular individual. This will vary enormously from person to person, depending on heredity, education, experience, and so on and will differ enormously in man and in animal. This variation, however, is no justification for the abandonment of investigation, but is rather a guide to the choice of the most elementary species and the most fundamental processes for experiment.

Prof E D Adrian, for the purposes of the discussion which he opened on Sept 24 in Section I (Physiology) of the British Association, presented the view that the structural organs involved—namely, the sense-organs, sensory nerve-fibres, and the collection of nerve cells with their interlacing fibres in the brain—work in a fairly simple way. At any rate, the messages or nerve impulses which pass from the sense-organs are fairly simple, each consists of a very brief wave of activity—in the larger fibres each point remains in the active state for only a few thousandths of a second and the wave travels at a speed of 30 metres a second or more. The passage of an impulse involves a very small expenditure of energy, but fortunately some

of it can be easily detected, for it appears as an electric current flowing between the active and inactive parts.

By amplifying these electric changes, Adrian has been able to record the passage of impulses in each nerve-fibre, and has found that a succession of impulses passes up to the brain whenever a sense-organ comes into action. An active sensory ending usually discharges a rhythmical series of impulses with a frequency in the neighbourhood of 20-100 a second, and the sense-organ, like the nerve-fibre, behaves with machine-like regularity, giving always the same discharge of impulses for the same stimulus provided that other conditions are unaltered.

Adrian has recorded similar electrical changes in the optic nerve, which developmentally is a part of the brain, and there is no reason to suppose that changes do not occur in the brain itself similar to those in the sense-organs and their nerve-fibres.

Prof Frank Allen, of the University of Manitoba, brought forward evidence of a quantitative character in support of the elementary and fundamental physiological basis of sensation. The same law is found to connect the magnitude of the response elicited by a definite adequate stimulus of a sensory organ irrespective of what the sensory organ may be.

Sir John Parsons also contributed to the discussion, pointing out, among other things, the valuable data derived from clinical examination of patients afflicted with such partial deficiencies as colour-blindness.

### University and Educational Intelligence

CAMBRIDGE—Candidates for the recently established Goldsmiths professorship of metallurgy are requested to communicate with the vice-chancellor on or before Jan 16. The salary attached to the chair is £1200 per annum.

The Raymond Horton-Smith prize for the present session has been awarded to Dr W D Newcomb for his thesis on the relationship between peptic ulceration and gastric ulceration and gastric carcinoma.

LONDON—Mr O L V de Wesselow has been appointed as from Dec 1, 1931, to the University chair of medicine tenable at St Thomas's Hospital Medical School. Since 1920 he has been chemical pathologist to St Thomas's Hospital.

ST ANDREWS—The last examination for the diploma of L L A has been held, and the scheme has now been wound up. Begun in 1877, when there was no opportunity for women to enter the universities and when the L L A examination afforded them an opportunity of obtaining a diploma attesting their attainments in literature, science, and philosophy, the scheme grew gradually up to the year 1909, when there were as many as 1090 candidates in one year. By that time the effect of the admission to the universities of women had diminished to some extent the usefulness of the examination and the numbers gradually decreased. During its existence the L L A has attracted 36,017 candidates and 5119 diplomas have been conferred.

THE sixth World Conference of the New Education Fellowship will be held at Nice on July 29-Aug. 12, under the presidency of Prof P Langevin, professor of experimental physics in the École Normale Supérieure, Paris. The theme for the Conference is "Education and Changing Society." Main lectures on the general theme have been arranged, also sectional lectures on special subjects and on progress within national systems of education, and study courses. Further information can be obtained from the Conference Secretary, New Education Fellowship, 11 Tavistock Square, London, W C 1.

## Calendar of Geographical Exploration.

Jan 10, 1811 —The Rocky Mountains

David Thompson discovered the Athabaska Pass, along the main route over the Rockies to Columbia. Thompson was one of the greatest land explorers, covering at least 50,000 miles of mainly unknown country and recording his surveys accurately and fully. For twenty-seven years he made innumerable astronomical observations on long journeys. The result was a survey of south-western Canada from Lake Superior to the mouth of the Columbia river, making possible the accurate mapping of its mountains, rivers, and lakes. Regions of the 'muskrat' country, north-east of Cumberland House, have never been visited since his time. Later, Thompson worked on the boundary survey after the Anglo-American war. Recognition of the importance of his work was tardy, for poverty prevented him from publishing either a map of his explorations or his "Narrative" or "Journals."

Jan 11, 1930 —The South Arabian Desert

Bertram Thomas set out on his second journey into the Rub'al Khali, when he penetrated almost to the centre of that arid waste. His journeys covered ground practically unvisited previously by any European, though Wellstedt, from the crest of Jebel Akhdar in 1836, had seen the great desert in the distance. Much new scientific information is now available about the region, including the first account of its drainage system.

Jan 12, 1878 —The Heart of Arabia

Wilfrid Scawen Blunt and his wife left Meskakeh to cross the Nafud desert southwards to Jabal Shammar. The poet and his wife, who was a granddaughter of Byron, had developed a romantic sympathy with bedouin society, and had been initiated into desert life among the Anaze and Shammar tribesmen of the Hamad and the Mesopotamian steppes. Blunt journeyed to Jaufr in quest of a bride for his 'blood-brother', a young Arab of the Palmyrene oasis. Thence he and Lady Anne decided to visit the Emir of the Shammar as European guests. Their achievement in travelling openly, with a woman in the party, through the strongholds of Arabian fanaticism is remarkable. Their records proved of the utmost value for the geography of this little-known region.

Jan 13, 1772 —Marion and Crozet Islands

N T Marion du Fresne discovered the islands now bearing the above names. Bougainville, on his voyage round the world, 1767-69, had brought back with him a native of Tahiti as a 'human curiosity'. The French Government wished to return the native to his home. Marion volunteered to take him to Tahiti, and sailed from Île de France (Mauritius) in October 1771 with two vessels. The unfortunate native contracted small-pox and died while the ships were anchored off Madagascar. Marion thereupon decided to go southwards to search for the antarctic continent. He named the island which he discovered on Jan 13, Terre de Espérance, because it gave him the hope that he was near the southern continent. The islands are bare and rocky, but the weather was foggy, and a multitude of white spots led the discoverers to think that there were flocks of sheep upon them. The *Challenger* expedition, 1872-76, explored the islands and found these spots to be moss patches. Marion's expedition went on to New Holland (Australia) and New Zealand. It made a stay of some duration in the latter, but Marion was murdered by the natives, and his lieutenant, Crozet, brought the vessels home.

The account of the voyage, with its full descriptions of Maori life, was compiled from Crozet's log.

Jan 14, 1699 —Australia and the East Indies

William Dampier sailed from the Downs on H M S *Roebeck*, one of the earliest government expeditions sent out from Great Britain purely for discovery. Dampier's account of his former voyage in the *Cygnnet*, when he had observed the shores and natives of New Holland (Australia), had roused the interest of the Earl of Pembroke, then Lord High Admiral, and Dampier was commissioned to explore the southern seas. He anchored in Shark's Bay, on the western coast of Australia, on July 7, 1699, and thence surveyed the coast for 900 miles. Leaving Australia, he discovered Dampier Strait, between New Guinea and Waigiou. He also proved that New Britain is an island separate from New Guinea, and surveyed much of its coast.

Jan 16, 1772 —Kerguelen Island.

Yves Joseph de Kerguelen-Trémarec, a Breton noble, sailed from the Île de France (Mauritius) commissioned by the French Government to search for "a very large continent to the south of the islands of St Paul and Amsterdam", a land on which the Sieur de Gonneville was supposed to have stayed in 1504. He found a land which he named South France. He thought it formed the central mass of the antarctic continent, and held out high hopes of its commercial importance. But on a second expedition in 1773 he discovered it to be bleak and barren, and Cook had in the meantime sailed far to the south of it in open seas, so that Kerguelen now knew it to be an island. He renamed it the Land of Desolation. It is to-day called Kerguelen Island in honour of its discoverer, and has from time to time been used as a base for valuable scientific observations.

## Societies and Academies.

### LONDON

Royal Meteorological Society, Dec 16 —W C Kaye and C S Durst. Some examples of the development of depressions which affect the Atlantic. Three typical cases show examples of (1) a polar depression being intensified by the introduction of warm air from the Gulf of Mexico, (2) the formation of a family of depressions between Pacific maritime polar air and warm Gulf air, (3) the formation of depressions on a quasi-stationary front. A majority of the families of depressions which cross the Atlantic originate in one or other of these ways —Alfred A Barnes. (1) Rain-gaugings near Belper and Duffield, Derbyshire. A complete analysis of the yearly readings taken at 19 rain-gauges at the southern end of the Pennine Chain during a period of 66 years from 1865 to 1930 inclusive —(2) Rainfall reviewed a common long-average period for each country of the British Isles. A new survey during a period of 68 years from 1863 to 1930 inclusive —W H Pick. Visibility with saturated air. The horizontal visibilities at Worthy Down and Felixstowe, over a period of four years, whenever the air was saturated are examined. All degrees of visibility (except the very best) were well represented. A large percentage of the cases of saturated air were unaccompanied by either fog or mist. The effect of wind force upon the visibility accompanying saturated air is also examined.

### PARIS

Academy of Sciences, Nov 30 —G Bigourdan. An influence of the moon —Lucien Cuénot was elected a non-resident member in succession to the late Eugène

Cosserat—A Marchaud Correction of an earlier communication—Alexandre Wundheiler Conditions for an inextensible flexible surface—Georges Bouligand A new extension of a theorem of Émile Picard—Mandelbrojt The generalisation of a theorem on holomorphic functions in a demi-plane—W K Turkin A generalisation of the theorem of Frobenius—Georges Ranque and Pierre Henry The determination of the characteristics of the viscous elongation of hot metals A modification of Kohn's method, in which the reversible extensions of the test-piece are utilised to regulate the temperature, the extension remaining constant The decreasing temperatures under constant load can be expressed as a linear function of the logarithm of the time—Émile Sevin Concerning binary systems—A Guillet Application of the deviation method and the zero method to the electromagnetic measurement of small deformations—M Pauthenier and Mme Moreau-Hanot The adsorption of ions by spherical conducting particles in an ionised field—Ch Sadron Ferromagnetic moments and the periodic system From the experiments described the author concludes that the atomic moments, in Weiss magnetons, of elements in the same column of the periodic table are identical—Antonie Rostagni Oscillations maintained by valves with positive grid—A Kastler The circular polarisation of the Raman radiation—A Cotton Remarks on the preceding communication A preliminary account of the action of a magnetic field of 46,300 gauss on the Raman lines—J P Mathieu The influence of the nature of the chemical linkages on the production of circular dichroism A solution of chromium hydroxide dissolved in tartaric acid contains a normally ionised salt it slowly changes into a complex salt from which ammonia fails to precipitate chromium hydroxide Facts are given which render very probable the hypothesis that the circular dichroism is proportional to the concentration of the complex compound formed in the reaction—Henri Muraour and G Aunis The variation of  $\rho d\epsilon$  with the density of charge for a vaseline powder  $B$  and a centralite powder  $B$  The phenomenon previously described for nitroglycerine powders is repeated with nitrocellulose powders—Guichard, Clausmann, Billon, and Lanthony The experimental method suitable for establishing the independence of the amount of hydrogen present and the hardness of electrolytic iron Reply to a criticism by Guillet, Roux, and Cournot—G Rumeau The velocity of crystallisation of the different forms of dimethyl tartrate—R Lespieau, M Bourguet, and R Wakemann The Raman effect and chemistry The cyclopropane nucleus The nucleus of a cyclopropane compound is characterised by (1) a very strong line near 1200 corresponding to the C-C linkage, and (2) by two strong lines at 3000 and 3065 corresponding to the C-H linkages The spectrum of the nucleus differs entirely from that of saturated open fatty chains—R Trehin The absorption of aqueous solutions of some chlorides in the ultra-violet Solutions of the chlorides of sodium, potassium, barium, and strontium were studied details of the methods of purification are given Absorption of very dilute solutions of these chlorides is due entirely to the presence of chlorine ions—Jean Cournot Results of corrosion tests on rustless steels—J Bougault and E Cattelain The elimination of the phosphate ion as lead phosphate in the analysis of salts by the wet method—André Meyer and Robert Vittenet The phthalone imides and their derivatives—André Demay The conditions of orogenesis and of Hercynian metamorphism in the southern edge of the Rodez massif—Georges Corroy The variations of facies and thickness of the

Argovian in the eastern border of the Paris basin—E Aubert de La Rue The presence of a Tertiary fossil flora in the Kerguelen Archipelago—R Lambert The tectonic of the western flank of the mountain of Néron, near Grenoble—J Dufay The emission bands of the aurora borealis in the spectrum of the nocturnal sky—Ladislav Gorczynski Maximum of intensity of solar radiation observed at Nice and Thorenc in the Maritime Alps—Octave Mengel The rôle of the condensation of water vapour in supplying springs—Pierre Lesage *Lepidium sativum* at different latitudes—Aug Chevalier The extension and propagation of the rosette disease in *Arachis* in Senegal—R Legroux and Kemal Djemil Lysis of the glanders bacillus and of the pyocyanic bacillus—Jean Regnier and Robert David Contribution to the study of microbial multiplication The influence of the composition of the liquid media usually employed in laboratories on the value of the microbial growth (*Pyocyanic bacillus*) A table showing the comparative results with seven media is given The microbial growth follows practically the same course with all the media—Remlinger, Manouelian, and Bailly Researches on the nerve centres of the tortoise inoculated with the rabies bacillus The virus of rabies, inoculated in the brain of *Testudo mauritanica*, preserves its virulence for at least six months This virulence occurs with the presence of Negri corpuscles and the formations described by Manouéhan and Viala in all forms of rabies No apparent symptom develops in the reptile—C Levaditi and A Vaisman The curative action of liposoluble bismuth in experimental syphilis without external symptoms Liposoluble bismuth (bivatol) exerts a strong and durable curative action on latent syphilis in mice—Ugo Lombroso The inoculation of man with bacterial strains isolated from Tunisian trachomatous subjects

## ROME

Royal National Academy of the Lincei, June 5—F Severi General resolution of Dirichlet's problem for biharmonic functions—C Somigliana Variability of mass A system of dynamics is deduced which preserves the general lineaments of classical dynamics without prescribing *a priori* a definite form of dependence of the mass on the velocity—L Cambi and A Cagnasso Dithiocarbamates and nitrosodithiocarbamates of iron—E Bompiani Integral surfaces of two or more equations with partial derivatives of the third order—Ugo Broggi A problem of interpolation—L Labocchetta The fundamental forms of discontinuous constants as circular functions—T Viola The dextro derivative of a function continuous towards the right and derivable towards the right—Miron Nicolesco An equation with partial derivatives characterising the means of Picone—Pia Nalli Rigid transports and relativity—G Sansone The partial convergence of the developments in series of orthogonal functions Extension of Kolmogoroff's theorem to developments in Fourier's series—G Mammanna The product of series capable of summation by Cesaro's method (2)—G Krall A complement to the theory of adiabatic invariants according to T. Levi-Civita—G Lampariello Propagation of waves in isotropic, but not necessarily homogeneous, elastic media—G Galanti Algorithms of motorial calculus—A Consiglio Power of a translatory-circulatory current in presence of a Joukowski obstacle An earlier communication (1930) has given an evaluation of the resultant of the dynamic actions of an irrotational, permanent, translatory-circulatory current on a Joukowski pisciform obstacle The power relative to such a current is now calculated—B Caldonazzo Vortex in a field limited by a cardioid.

In general, the presence of salient cusps on rigid walls bathed by a perfect liquid in plane motion contributes to the dynamic actions exerted on the walls themselves. The case here considered is the motion caused by a free, isolated vortex in the field limited by a cardioid, which exhibits a cuspid salient with respect to the field of motion—G Cecchini. The absolute magnitude of the Cepheids. Although difficult to treat, parallactic data obtained by direct observation are able to confirm, by way of laws valid for ordinary stars, the necessity of a systematic correction in the absolute magnitude of the Cepheids determined from the period-luminosity curve. The correction found for the zero point is in the sense and of the order established by various means by several investigators and indicates that the distance of every celestial object deduced on the basis of Shapley's curve should be reduced by the factor 0.6—M Tenani. Contribution to the knowledge of the tides of the Arctic Ocean. Consideration of the data, collected during the sojourn of the *Città di Milano* at Spitsbergen in June-July 1928, furnishes fresh confirmation of the view, expressed by Nansen and supported by others, that the Arctic Ocean is continuous. It is not in accord with Harris's hypothesis of the existence of a wide expanse of unknown land in the zone still unexplored—G A Barbieri. Compounds of bivalent and of trivalent silver. Argentopyridine persulphate, in which the silver functions as a bivalent metal, forms mixed crystals with the analogous cadmiopyridine persulphate, and argentiphenanthroline persulphate with cadmiophenanthroline persulphate. When hydrolysed, both the so-called silver peroxodinitrate,  $\text{Ag}_2\text{NO}_{11}$ , obtained by electrolysis of concentrated nitric acid solution, and a nitric acid solution of the oxide  $\text{Ag}_2\text{O}$  yield the oxide  $\text{Ag}_2\text{O}_3$ , for which the equivalent ratio between active oxygen and silver has the value 1.51—L Mascarelli and D Gatti. Contribution to the knowledge of diphenyl and its derivatives (8). New 2'-disubstituted derivatives of diphenyl. The compounds described are the nitrochloro, nitrobromo, nitroiodo, nitrohydroxy, aminochloro, aminobromo, aminoiodo, chloroiodo, chlorobromo, and iodobromo derivatives. The scheme was as follows:  $\text{NO}_2 \cdot \text{C}_6\text{H}_4 \cdot \text{C}_6\text{H}_4 \cdot \text{NO}_2 \rightarrow \text{NH}_2 \cdot \text{C}_6\text{H}_4 \cdot \text{C}_6\text{H}_4 \cdot \text{NO}_2 \rightarrow \text{X} \cdot \text{C}_6\text{H}_4 \cdot \text{C}_6\text{H}_4 \cdot \text{NO}_2 \rightarrow \text{X} \cdot \text{C}_6\text{H}_4 \cdot \text{C}_6\text{H}_4 \cdot \text{NH}_2 \rightarrow \text{X} \cdot \text{C}_6\text{H}_4 \cdot \text{C}_6\text{H}_4 \cdot \text{X}$ , where X represents a halogen atom—G Tallarico. Preservation and productivity of corn grain. Functional predetermination. In order to maintain the activity of the embryo of seed wheat during storage, the conditions must be such that the consumption of the reserve food material, to be utilised by the young plant, is reduced to a minimum and that the lethargic rest of the embryo is not disturbed. This is attained by limiting the respiratory activity to the minimum required to keep the seed in a living condition. The seed should, therefore, be dried and stored in a cool place, and accumulation of carbon dioxide in the mass should be permitted. Experiment shows (1) that grain from the interior of an undisturbed heap gives higher yields of both grain and straw than that from the surface layers of the same heap, and (2) that grain left at rest furnishes higher yields than the same seed subjected to turning during storage.

#### SYDNEY

Linnean Society of New South Wales, Sept. 30.—H L Jensen. Contributions to our knowledge of the Actinomycetales (2). The definition and subdivision of the genus *Actinomyces*, with a preliminary account of Australian soil Actinomycetes. These organisms can be divided into two main groups (1) *Actinomyces*, which produce an aerial mycelium with spores. These

are the common soil inhabitants (ii) A new genus in which spores are not produced in the aerial mycelium, and there is a tendency to assume a bacterium-like appearance. These are more rare soil forms, but include many parasitic forms—A Jefferis Turner. Revision of Australian Lepidoptera—Supplementary Corrections and additions to families previously revised, and descriptions of four genera and thirty-nine species as new—R J Tillyard. The wing-venation of the order Isoptera (1). Introduction and the family Mastotermitidae. This paper deals with the wing-venation of the archaic Australian termite *Mastotermes darwiniensis* Frogg. The determination of the homologues of the veins by this method shows some interesting results, the most important being the delimitation of the anal lobe of the hindwing, which is now proved not to be homologous with the anal fan of the Orthoptera, but is rather comparable with the alula of the Diptera. An interesting discovery was made in the form of a hitherto unrecorded small wing-flap attached to the clavus of the forewing and folding beneath it, this closely resembles the structure called the alula in the coleopterous family Hydrophilidae. It appears to be a reduced homologue of the anal lobe of the hindwing.

#### WASHINGTON, D C

National Academy of Sciences (*Proc.*, Vol. 17, No. 9, Sept. 15).—Emma L Fisk. The chromosomes of *Lathyrus tuberosus*. The haploid number is seven, as in other species of *Lathyrus*. The chromosomes are unusually large and varied sizes and shapes—Th Dobzhansky and Jack Schultz. Evidence for multiple sex factors in the X-chromosome of *Drosophila melanogaster*.—John W Gowen. Body pattern as related to mammary gland secretion. Analysing the data from about 6000 Jersey cows, it is shown that weight and a wedge-shaped form when viewed from in front are indicative of milk yield. Other dairyman's 'points' are without significance. All correlations of dimensions of an animal and milk yield are materially influenced by the cow's age, and for the purpose of this paper, the data were adjusted to the age of 8 years 3 months—F Zwicky. Why crystals exist. Ordinary cohesive forces with action radii of the order of atomic dimensions are responsible for condensed states of matter but are not characteristic for the crystalline state. The transition from liquid to crystal is sharp and can only be effected by the simultaneous co-operation of large numbers of atoms in a directional arrangement, this co-operation will not generally have the same symmetry character as the primary structure of the crystal. Hence crystals are supposed to have a primary structure, revealed by X-ray analysis, on which is superimposed a secondary structure, the former is characterised by structure insensitive properties, the latter by structure sensitive properties—Paul S Epstein. On the air resistance of projectiles. A theoretical discussion. Solutions are derived of Euler's equations of hydrodynamics for velocities greater than that of sound for the two-dimensional case of polygonal contours. At very high velocities the expressions are valid for contours with curved sides and for three-dimensional bodies—T L Ho. High vacuum pressure control apparatus. A hot wire or ionisation gauge is attached to the vacuum system to be kept at constant pressure. This gauge is connected with a galvanometer which controls a vacuum tube amplifier, the latter in turn controls magnetically an iron float in a U-tube of mercury, so arranged that it opens or closes a connexion between the vacuum system and a vacuum reservoir attached to a pumping system.

## Forthcoming Events.

## Societies

## FRIDAY, JANUARY 8

- ROYAL GEOGRAPHICAL SOCIETY, at 3 30—Mrs Murray Chapman Through Lapland in Winter with Sledge and Reindeer (Christmas Lecture for Young People)  
 INSTITUTION OF MECHANICAL ENGINEERS, at 6—S B Freeman Modern Types of Propelling Machinery for Mercantile Marine Use (Thomas Lowe Gray Lecture)  
 GEOLOGISTS' ASSOCIATION (at University College), at 7 30—Dr W F Whittard An Expedition to East Greenland, 1929 (Lecture)

## SATURDAY, JANUARY 9

- ROYAL INSTITUTION OF GREAT BRITAIN, at 3—Sir William Bragg The Universe of Light (Christmas Lectures) (6)  
 Light from the Sun and the Stars

## TUESDAY, JANUARY 12

- PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8 30—W Deacon The Romance of Perfumes (Lecture)

## WEDNESDAY, JANUARY 13

- ROYAL SOCIETY OF ARTS, at 3—Prof E N da Costa Andrade The Vacuum, or the Importance of Nothing at All (Dr Mann Juvenile Lectures) (2)

## THURSDAY, JANUARY 14

- ROYAL GEOGRAPHICAL SOCIETY, at 4—Revision of Bye-Laws—At 5—Geographical Film  
 LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5—Discussion on Generalisations of Fourier's Integral  
 INSTITUTION OF CIVIL ENGINEERS (Birmingham and District Association) (at Chamber of Commerce, Birmingham), at 6—N G Gedye The Mechanical Handling of Coal at Ports (Vernon Harcourt Lecture)

## FRIDAY, JANUARY 15

- SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry—South Wales Section) (at National Oil Refineries, Skewen), at 7—Dr A E Dunstan Liquid Fuels To-day and To-morrow (Lecture)

## Public Lectures

## FRIDAY, JANUARY 8

- IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5 30—Dr T M Finlay The Evolution of Landscape Vulcanism (Swiney Lectures) (2)

## MONDAY, JANUARY 11

- IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5 30—Dr T M Finlay The Evolution of Landscape Vulcanism (contd) (Swiney Lectures) (3)

## WEDNESDAY, JANUARY 13

- IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5 30—Dr T M Finlay The Evolution of Landscape Vulcanism and Landscape (Swiney Lectures) (4)  
 BELFAST MUSEUM AND ART GALLERY, at 8—Prof J Kaye Charlesworth Crystals

## THURSDAY, JANUARY 14

- SCIENCE MUSEUM, SOUTH KENSINGTON, at 4 30—D Brunt Meteorology in History

## FRIDAY, JANUARY 15

- UNIVERSITY COLLEGE, at 5—Dr A S Parkes The Physiology of Reproduction (Succeeding Lectures on Jan 15, 22, and 29, and Feb 5, 12, and 19)—G P Wells Comparative Physiology (Succeeding Lectures on Jan 15, 22, 29, Feb 5, 12, 19, 26, and March 4, 11, and 18)  
 IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5 30—Dr T M Finlay The Evolution of Landscape The Instability of the Earth (Swiney Lectures) (5)

## Exhibition

## JANUARY 11 (CONTINUING FOR A MONTH)

- ROYAL METEOROLOGICAL SOCIETY (at Science Museum, South Kensington)

## Discussion

## JANUARY 12 AND 13

- FARADAY SOCIETY (in Biochemical Laboratory, Oxford)—General Discussion on The Adsorption of Gases

Jan 12, 2 30 to 6—Prof H S Taylor General Introduction The Adsorption of Gases

Section I Experimental Methods—Prof E K Rideal Introductory Paper

Prof J A Becker The Use of Thermionics in the Study of Adsorption of Vapours and Gases

Dr H Cassel The Thickness of Adsorbed Films on Mercury

Dr H Dohse and Prof H Mark On Mixture Isotherms at Active Points

Dr J Chariton, Dr A Schalmkoff, and Prof N Semenoff On the Behaviour of Adsorbed Atoms

Dr F P Burt Sorption of Gases by Glass

C N Hinshelwood The Role of Surface Adsorption in Chain Reactions

Prof F G Tryhorn and W F Wyatt Adsorption of Saturated Vapours by Porous Substances Experimental Methods

Jan 13, 9 30 A M to 1 P M

Section II Kinetics and Energetics—Prof H Freundlich Introductory Paper

Prof K F Bonhoeffer and Dr A Farkas On Adsorption and Reflection Processes in the Interchange of Hydrogen and Metals

Dr W Frankenburg New Experiments in the Adsorption of Hydrogen, Nitrogen, and Ammonia on Metallic Tungsten and the Mechanism of Catalytic Ammonia Decomposition by this Metal

Prof A F Benton Adsorption and Solution of Gases by Metals

Prof A J Allmand, W J Burrage, and R Chaplin Discontinuities in Adsorption Processes

Dr F H Constable The Kinetics of Adsorption in Relation to Reaction Velocity

A R Ubbelohde The Occlusion of Hydrogen by Palladium

A C G Egerton and A R Ubbelohde The Occlusion of Hydrogen by Palladium, Part II

A R Ubbelohde The Influence of Nuclear Spin on the Sorption of Hydrogen on Charcoal

Dr E B Maxted and N J Hassid The Kinetics of the Adsorption of Hydrogen on Platinum and Nickel

Prof W E Garner The Heats of Adsorption and the Kinetics of Adsorption

F E T Kingman The Adsorption of Hydrogen on Charcoal

Prof H S Taylor and A Sherman Activated Adsorption and the Para-Hydrogen Conversion

H W Thompson The Explosive Combination of Hydrogen and Oxygen The Function of Water in Gaseous Reactions

2 30 to 4 30

Section III Theories of Adsorption—Prof M Polanyi Introductory Paper

Prof M Volmer The Migration of Adsorbed Molecules on Surfaces of Solids

Dr R H Fowler Theories of Adsorption of Gases Quantum Mechanics of the Reversible Electrolytic Cell and of Electrolysis

Prof E Huckel Theory of Heat Evolved in Capillary Condensation

Prof A Magnus The Electrical Theory of Gaseous Adsorption

Dr J K Roberts The Interchange of Energy in Collisions between Gas Atoms and Solid Surfaces

A F H Ward The Suggested Existence of Activated Adsorption

Prof J W McBain Persorption and Mono-molecular Sieves

Dr Schuster Hydrogenation of Adsorbed Ethylenic Hydrocarbons

C Evans Deviations from the "Ideal" Translation Motion of Adsorbed Molecules

## Official Publications Received.

## BRITISH

The University of Manchester. The Manchester Museum. Museum Publication 101. Report of the Museum Committee for the Year 1930-31. Pp 22 (Manchester) 6d net.

London School of Hygiene and Tropical Medicine (University of London). Seventh Annual Report to the Court of Governors 1930-31. Pp 17. Report by the Dean on the Work of the School for the Year ended July 31, 1931. Pp 54. (London).

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Bulletin, Geotechnical Committee, Government Railways of Japan. No 1, June. Pp 338. (Tokyo).

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SATURDAY, JANUARY 16, 1932.

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## Knowledge and Social Service.

IT may appear otiose to compare the South African War with the Great War. But one curious difference *saute aux yeux*. At the conclusion of the South African War, there was fierce denunciation of our Army, of our aristocracy, of our neglect of science. The attempt was even made to reform the War Office! Prof H E Armstrong, now a Nestor both among men of science and among educationists, was outspoken on the neglect of science in our schools. To him was largely due the creation of the Educational Science Section of the British Association in 1901, at the first meeting of which he urged the scientific treatment of education in all its branches, and the introduction of scientific conceptions into every sphere. He is, however, still far from satisfied with the scope and method of scientific teaching in our schools, and our columns from time to time afford evidence that he has not reached the end of his long, long trail winding towards a perfectly organised nation.

Norman Lockyer, exemplar of that race of pioneers who "debouch upon a newer, mightier world", founded the British Science Guild in 1905 with the object of promoting the application of scientific methods and results to social problems and public affairs. He urged with success upon the Government the need for more liberal support of university education and scientific research. Haldane, with prevision of the life-and-death struggle facing the nation, worked out a scheme for the development of technological study and research at South Kensington, significantly called the London Charlottenburg scheme. The University of London, under the brilliant guidance of Sir Arthur Rucker, endeavoured to set its house in order. The University of Birmingham, our first civic university, founded in 1900, was the prototype of a powerful group of modern universities. The Government, ceasing to dally with the question of educational reform in its broader aspects, accepted with a single gesture Robert Lowe's advice to "educate your masters" and Matthew Arnold's advice to "organise your secondary education."

"Bliss was it in that dawn to be alive,  
But to be young was very Heaven!"

Contrast the vigour of those pregnant years, especially the earlier years after the South African War, with the temperament of the public since 1918. The Great War summoned the whole nation to arms. Silent and abashed we stand before the Cenotaph, asking whether any sins of

commission or omission on our part have contributed to the loss of our friends, to the cataclysm which has overtaken the world. Armistice Day is celebrated with increasing solemnity year by year. We have the feeling that the childish question, "What did you do, daddy, in the Great War?" is an indictment rather than an ingenuous request for information. We cannot school ourselves to learn the stupendous lessons of the War. Like that adorable dreamer, we cherish lost causes and forsaken beliefs, unpopular names and impossible loyalties. The 'schoolmen' attempt again to spellbind us with their words. The War Office 'carries on'.

That mental attitude has continued ominously for thirteen years. But the shattering events of the last few months have awakened the nation to a more realistic frame of mind. Especially significant, we would suggest, is that university professors have been stimulated to express their opinions more freely, to give a lead to an inarticulate but well-disposed public, reviving a sound tradition established by men like Playfair, Huxley, Norman Lockyer, Roscoe, and other men of science who could be named. Two recent pronouncements of this *genre* deserve special mention.

Prof Ruggles Gates, professor of botany and plant biology in the University of London, addressing the Educational Science Section of the British Association on "Eugenics in Education", at the recent centenary meeting, said that the elements of our community most capable of producing men of achievement, intellectually, socially, or financially, are failing to reproduce themselves, and are being eliminated "unobtrusively but fatally". Parliament, he declared, is almost wholly lacking in the type of intellect capable of restoring the nation to biological soundness by legislation. "One must conclude that almost every important legislative measure since the War, when our racial and economic resources were so greatly in need of conservation, has been effective rather in hastening racial degeneration by its disregard of the fundamental facts of biological inheritance." Prof Gates pleaded not for more education but for better education, especially in those biological principles which underlie national progress. Following that would come leadership on questions of population, marriage selection, the production of children, racial crossing, and related matters.

The other pronouncement was even more outspoken and relevant to our immediate difficulties. Prof John Hilton, the first Montague Burton

professor of industrial relations at the University of Cambridge, referred in his inaugural lecture to the depressed condition of industry. The cost of living has fallen but wages and interest have held, hence unemployment. Industry will have to live on its own fat, which is already very lean, and nobody will feed it with the capital which comes from savings. There is no formula to settle wages in this or that industry, to adjust the claims of worker, investor, and public—only a code of rules which each of the contestants ought to observe. For many years industry has been baffled and spellbound by forces not its own. Take the curse from industry and it will give the world good service.

Whatever adjustments are required to ensure progressive social service should be based upon the best knowledge available. Without, therefore, expressing approval or disapproval of the professorial pronouncements referred to, we welcome their appearance as a sign of new life. "The War and the Russian Revolution", says Bertrand Russell, "have made all timid men conservative, and professors are usually temperamentally timid", and Hogben refers to "the intellectual discouragement which is the heritage of a World War". Timidity and intellectual discouragement have only complicated our problems since the War! How long must a distracted world wait before its wise men shall be able to sound again a note of encouragement?

"For, lo, the winter is past, the rain is over and gone, the flowers appear on the earth, the time of the singing of birds is come, and the voice of the turtle is heard in our land"—*The Song of Solomon*  
T. L. H.

### An Odyssey of Science.

*Past Years an Autobiography* By Sir Oliver Lodge. Pp 364 + 13 plates (London: Hodder and Stoughton, Ltd., 1931) 20s net.

IT can confidently be said that the life-story of no man in the scientific world to-day, is likely to be of greater interest to us than that of Sir Oliver Lodge. There is more than one reason for this, but the one above all others which we would have Sir Oliver realise, is that he has gained a quite peculiar place in the regard of his fellow-countrymen. His eminence in science is known to the multitude, and there is no one who has shown greater gifts in teaching them about the things in science on which they particularly want more light. It may be quite true that it is Sir Oliver's concern with matters

'psychic' which has aroused the widest interest of all, and will, perhaps, secure him most readers. But those in science whose memories go back to his early days, will say that they saw him then clearly predestined to fame as a scientific discoverer and as a leading expositor of scientific thought to his generation.

On Sir Oliver's position within the scientific world it is, of course, unnecessary to enlarge here, and, fortunately for the writer of this notice, there appeared recently in these columns (Dec 12, p 982) an appreciation of his chief work in the advancement of science, contributed by a more authentic hand—"R. T. G." Readers of *NATURE* will all feel that for longer or shorter years they have not only learned from him, but have also lived, as it were, in his genial company. Different readers will want to know different things in particular about his life, and so far as one can judge, none will fail to find them in this book.

The difficulty of writing the book must have been very great, even to such a practised hand. The wealth of material alone was calculated to create dismay, but most impressive of all is the evidence the book gives of the difficulties confronting an honest man, when he tries to make sure of recollections of his own life. In the narrative of ordinary events, this may not matter very much, but when a man is to record the course of his thought, the exact sequence of events, and his particular share in discovering, it is very different. The discoveries in which Sir Oliver shared have been of the kind round which the historians of science gather in subsequent generations, with unceasing curiosity and ever sharper scrutiny. At least three accomplished chemists are busy to-day still auditing the intellectual accounts of Priestley and Lavoisier. Happily, in the scientific world, the private 'exchange of ideas' is widely prevalent, both nationally and internationally. But here, though without evil intent, exchange may often be robbery. We continually witness men having their own ideas, like their own jests, presented to them as fresh-minted from another mind. Nowhere does Sir Oliver show his qualities more arrestingly than in dealing with this difficulty in relation to his greatest scientific discovery. He does not balk the reader of the pleasure of listening to first-hand personal memories, the incidence of ideas, the plans of campaign, the talks with friends, the obstacles to progress, the 'ifs' and 'might have dones'. No one knows better than he how to keep human. But when we come to the question, so often asked of his scientific

friends, "What part exactly did Sir Oliver Lodge take in the discovery of electro-magnetic radiation?" he provides us with a reply by reprinting words used by the president of the Royal Society in 1899, beginning "The Rumford medal is given to Prof Oliver J. Lodge in recognition of his researches on radiation and on the relations between matter and ether."

Space can suffice for little more than a general indication of the course which Sir Oliver has taken in his book. The tale extends from very early days, where it is relatively full, through middle life, where there is necessarily great compression, finally to the present day, where we should have to regret much left unsaid, if it were not already within our memories. Here, as in other ways, Sir Oliver shows a talent for omission; he has spared the reader minute reference to 'sources', lists of books and papers, and vexatious footnotes; he has scarcely drawn at all upon what must be a prodigious store of correspondence. Those who have lived longest beside Sir Oliver, and some of those on close terms of friendship, will find much new to them, and of exceeding interest, especially about his earliest days. The younger men will find here a graphic story of the state of physical science before the days of the 'Revolution'. They will see where thought was, who and what men were in the expectant world of science. Speaking in 1889 he said, "the long line of isolated ripples of past discovery seem blending into a mighty wave, on the crest of which one begins to discern some oncoming magnificent generalisation. The suspense is becoming feverish, at times almost painful." On the great questions of to-day, physical and philosophical, Sir Oliver gives in compact and clear terms his present opinions, and they are likely to carry comfort to some who are in sore perplexity.

At the outset of Sir Oliver's story, we learn some interesting facts of genealogy, such as that his paternal grandfather, who was in Anglican orders and also a schoolmaster, brought in an Irish strain, that his father, originally intended for medicine, went from the paternal home in Essex to settle amid the Five Towns, where at Penkull, near Stoke, this, the first of seven sons, was born. To a wonderful mother, the son ascribes, besides much else, the intellectual inheritance of himself and his distinguished brothers Richard and Alfred.

No part of the story of his life is likely more to touch the heart of readers than that dealing with Oliver Lodge's schooldays. It tells of a child, with exceptional appetite and aptitude for learning, in the

hands mainly of bad teachers of mainly uncongenial subjects. That was, no doubt, the common case then, but the accompanying cruelty to body and spirit was such as to make Sir Oliver say now "My schooldays were undoubtedly the most miserable part of my life." But here, as elsewhere, the victim says what he can for those who have despitefully used him, and he seeks out good in all the uses of adversity.

Schooldays were ended at fourteen by an exacting father, who for the next seven years set himself inflexibly to immerse and retain his eldest son in his business. This business was a prosperous agency for the supply of blue-clay and other requisites to the potters. It involved not only keeping the books but also continual travel within and beyond the Potteries. The story of these hard years of school and business is shot with many gleams of sunshine. We see the first lure of science, the earliest efforts, almost clandestine, at experiment. Then emancipation begins through the strong and benign influence of his mother's sister, Miss Heath ("Aunt Anne"), who lived in Fitzroy Square, London, and had been the first to feed her nephew's appetite for science. She comes into the story like a good fairy. During a winter with her, he attended classes and lectures, Tyndall became his hero, and from the Royal Institution he "walked home, as if on air." After his return from this to servitude we read of rapid developments, among other things, preparation for London matriculation (1871).

During two successive years, Lodge spent a period at the Royal College of Science, London, attending the special courses for science teachers. Then comes the final determination to break away, which, after his failure to attain the desired haven of Cambridge, brought him to University College, London. There, besides the great mathematical teachers, Clifford and Henrici, the young man found a friend indeed in Carey Foster. With £50 a year, assigned to him by Foster for assistance in teaching work, living as a "rebel from home" a life of real privation for three years in Camden Town lodgings, Oliver Lodge then set himself at last fairly on the highway along which he was to travel thenceforth. He became assistant professor of physics at University College. Then, too, began the splendid companionship that brings much radiance into this story of past years. Lodge left London in 1881 to become the first professor of physics at University College, Liverpool. In 1900, under the influence of Joseph Chamberlain, he was made the first Principal of the new University at Birmingham, remaining there until he resigned

in 1919 and went to live near Salisbury. Such, in bald outline, was the course of events. They are not dealt with consecutively in the book, and the whole shaping and chaptering of it may not please literary formalists, but somehow it all seems just right for the purpose.

Sir Oliver has shown, to an extent that few could safely attempt, how he has played the great game of life. The frank record of his difficulties and doubts, his strivings and disappointments, his ambitions and defeats, will not only strike many responsive chords in the minds and hearts of the elders, but also will afford invaluable aid to younger men. They will see clearly depicted many difficulties that are among the hardest not only in the art of scientific discovery, but in life itself. They will see how at times crises arise, fate—and conscience, too—seeming to point with equal fixity both right and left. Those who study education will find here a rich mine. Sir Oliver does not descant much upon the teacher's art, but he exhibited it to a supreme degree in his "first and only text-book", that on "Mechanics", written in 1897, before his first appointment in the teaching world, in his "Easy Mathematics" (1906), and in every effort he has made through life to instruct his fellows. In these columns and elsewhere he has laid us under a heavy debt by his lucid exposition of the revolutionary modern discoveries in physical science. In particular he has been solicitous that the world should appreciate the great conquests that have been in progress at Cambridge during the last forty years.

It is hopeless to enumerate the scientific and human topics on which the book touches, for Sir Oliver looks back on so many "crowded hours of glorious life." The versatility of his interests has been so great that he is not free from the misgiving that he might have done better had it been less. The first occasion on which the present writer met Sir Oliver was when he was expounding an ingenious graphical symbolism for organic chemistry, and certainly the chemists have always felt him to be a very near relation. He had the companionship of philosophers, including an intimate friendship with Arthur Balfour. He has, indeed, moved among all sorts and conditions of men, and browsed in many pastures.

There is one matter of which mention must not be omitted. On all grounds, public and personal, Sir Oliver had warrant for allotting a relatively large share of pages to the history of his experiences, and a recapitulation of his faith, in matters 'psychic'. From the days at University College

in London, when he made the acquaintance of Edmund Gurney, through his experiences at Liverpool, Birmingham, Cambridge, in the island home of Richet, up to the present day the tale is told. It is told, as all else in the book is told, with exactly the same candour and the same control. We can confidently say that it provides just the authentic summary that so many men of science have wanted. More than that there can be no need to say in this notice.

On his way through life, Sir Oliver Lodge has enriched the world with many books. Greatly as these books have been, and are, prized, no one will be more ready than their author to say they will not all endure. Of one, "Modern Views of Electricity" (1889), it has already to be said that after a long and most useful day it has, in one sense, ceased to be. "The discovery of the discontinuous nature of electricity", Sir Oliver says, "caused the book to go out of print." But of this autobiography we shall surely say that no end can be foreseen to its acceptability and service in future generations. It is written by one who is veritably a giant in these days, a man of wonderful endowments and influence. He has participated in revolutionary discoveries in science, and has been a leader in perhaps the most fateful movement of his time—that which is at last making our race conscious of the mighty part that science must henceforth play in human thought and action. He has written of his past years in the spirit of one who wishes to bequeath what he can of the wealth of his experience and his stores of wisdom, and so has produced a human document of rare and abiding interest.

We see in his book some reflection of the nearest intimacies and greatest influences that have affected Sir Oliver's life, above all, those from within his own home. From that we come to understand a little of what has conferred upon this man, who has lived so strenuous a life, the serenity with which he walks among us in these later days, and the sway he exercises upon his fellow-men.

When a man has stepped, however lightly, into his ninth decade, it seems unfair to exact a great deal from him. But many readers of NATURE must have been present during the British Association meeting last September, at the great debate on the recent trend of science, and have heard Sir Oliver sum up, with such sure touch, the performance of each of the protagonists who had been engaged. All who were present will look forward not only with hope, but also with confidence, to further gifts from the man who has already given so much.

ARTHUR SMITHELLS

## Medical Bacteriology

*Medical Research Council. A System of Bacteriology in relation to Medicine. Vol 8. By W. Bulloch, L. Colebrook, J. Cruickshank, R. Cruickshank, A. Dawson, J. T. Edwards, F. Griffith, L. W. Harrison, E. Hindle, Ivy Mackenzie, A. Robertson, R. St John-Brooks. Pp 390. (London: H.M. Stationery Office, 1931.) 21s net.*

CHAPTER I of this volume deals with the Fungi pathogenic to man and is a valuable addition to the ordinary bacteriological literature. We agree with the authors that the space allotted to mycology is so restricted that it is impossible to cover the field even in summary, and we feel that the volume would have been improved if considerably more space had been given to this subject, which is so inadequately dealt with in all medical works. The gain to the book would have been great, and the loss would have been slight if some of the other chapters—for example, those on syphilis and the normal bacterial flora of man—had been even severely cut by the editors in order to give more space to mycology. The authors, however, have made the most of the pages allotted to them, and we congratulate them on a really valuable contribution.

We are glad to see emphasis laid on the fact that growth of these organisms takes place on the common laboratory media, and that, though Sabouraud's medium has advantages, it is not essential in the study of the fungi of ringworm and other conditions.

The chapter on actinomycosis, though short, contains all the essential points, but leaves us still in doubt as to the origin of most of the cases. Bostroem's original view is regarded with grave suspicion, but the alternative hypothesis of alimentary tract infection which the authors favour does not seem to have any more clear proof. The example given of infection round a fragment of a carious tooth found in an actinomycotic lung seems to us to give quite as much support to Bostroem's view as to the other one.

In view of all the work done on the actinobacillus as a causal agent in many of the cases of so-called 'actinomycosis' in cattle, the organism, we think, deserves more attention than has been given to it in the short note by Dr. Griffith, and does demand a revision of the work on actinomycosis.

The short chapter on pathogenic Leptothricæ by Dr. Ivy Mackenzie, giving, with much other information, his well-known observations on the two phases of the meningococcus, is of interest, and though we may not agree with some of his views,

yet the inclusion of this article is thoroughly justified and we think it deserves very careful study

Chaps iv, v, and vi, on the spirochaetes, are excellent. Though the information given in some cases is very limited, yet for a "System" of this kind it is probably ample, and we congratulate the writer on a very valuable article.

Chap vii, on syphilis, is by Col Harrison. This is a very full article and is not confined to the bacteriological aspects. Pathology and serum therapy are also dealt with fairly fully. The various serum tests are fully described. The article is very comprehensive and well written, as one would expect from a man who must be regarded as a leading authority on the subject. Our only criticism is that a good many of the details which are common in all ordinary textbooks might have been omitted with advantage to the readers, but the inclusion does not in any way minimise the value of the contribution as a whole.

The chapters on rat-bite fever, leptospiroses and yaws do not call for any special comment. They give all the important information on these diseases and give it in a very satisfactory way.

Chap xi, on the normal bacterial flora of man, is admittedly a difficult one to write, as there must be a considerable variation in different individuals not dependent on any single factor. Climate, food, etc. must all play their part. To get any standard of real value would mean a very extensive and prolonged investigation. The writers of this chapter have given us a great deal of information, and have given it well, but we cannot say that much which is either new or of real value has been added to our already rather confused store. It is perhaps well that this chapter is included to make the "System" more complete, but we cannot be enthusiastic over what is, and possibly must be, a mere compilation of observations by many authors. The authors have attempted to bring some order into the confusion which exists, and with a certain amount of success. We still are, however, very uncertain as to what are really 'normal' and 'abnormal' bacteria in the various situations in an apparently healthy man and which are to be regarded as pathogenic. The portion of the chapter on the aciduric group of intestinal organisms with which the chapter closes, is, in our view, the best part of the article, and we feel that if more had been done along these lines a more valuable contribution would have been made.

Chap xii, by J. T. Edwards, is on swine erysipelas, and gives a fairly full account of the disease and the organism concerned. J. M. BEATTIE

### Mineral Treasures in South Africa.

*Mineralische Bodenschätze im südlichen Afrika*. Von Prof. Dr. Hans Schneiderhohn. Mit Beiträgen über die Diamantlagerstätten Südafrikas von Prof. Dr. Erich Kaiser und die Kohlenvorkommen Südafrikas von Prof. Dr. Paul Kukuk. Pp. viii + 111. (Berlin • N. E. M. Verlag G. m. b. H., 1931.) 18 gold marks.

PROF. SCHNEIDERHOHN was one of those who had the good fortune to attend the fifteenth meeting of the International Geological Congress held in South Africa in 1929, the conferences and excursions in connexion with which ranged over an area extending from Cape Colony to Northern Rhodesia and from South-West Africa to Natal. Because of his special knowledge of the geology and ores of South-West Africa he acted as a director of one of the excursions to that region, conducting a large party over the mining field of Otavi, of which he had made a study in previous years. He also took part in several excursions conducted by others. During his travels he kept records of the areas visited, and on returning to Europe wrote these up into a series of articles, which were published by *Metallwirtschaft* between December 1929 and June 1930.

At the suggestion of the editor of that journal, Dr. Schneiderhohn has now elaborated these articles and assembled them in a single volume, entitled "*Mineralische Bodenschätze im südlichen Afrika*." The volume, making no claim to be encyclopædic, confines itself to fields visited by the author or by some of his German colleagues. It is divided into six sections, dealing severally with the Congress programme, excursions in South-West Africa, in the Union of South Africa, in Southern Rhodesia, Northern Rhodesia, and the Belgian Congo.

The section on South-West Africa includes a general account of the geology, and special descriptions of the mineral-bearing pegmatites of Namib, the copper-lead-zinc deposits of Otavi, the associated vanadium ores, etc. That on the Union comprises accounts of the Witwatersrand gold-field, and of the diamond, coal, and iron deposits of South Africa as a whole, the diamond occurrences being described in collaboration with Prof. E. Kaiser of Munich, and the coal by Prof. P. Kukuk of Borchum. There is also a good description of the Bushveld igneous complex and of the chromium, nickel, platinum, and tin mineralisations genetically connected with it.

Under Southern Rhodesia the general geology



is summarised, and special reference made to the asbestos and chromite mines, and to the Great Dyke and its associated ore-deposits. The section relating to Northern Rhodesia is particularly interesting. It epitomises the geology so far as is at present known, and gives good accounts of the lead-zinc-vanadium ores of Broken Hill, and of the deposits of the great copper mines—Bwana M'Kubwa, Mufulira, Roan Antelope, N'Kana, N'Changa, etc.—now in course of development. It is shown how the Rhodesian geology carries on into the Belgian Congo, and interesting accounts are given of the copper-field of the Katanga and of the remarkable uranium and radium deposits of Chinkolobwe.

The book runs to about 110 pages, and is interestingly written. It is profusely illustrated with photographs, maps, and sections, some of the maps being particularly valuable, because they represent the latest results of geological surveys now actively in progress. Although necessarily based in large measure upon the work of others, it contains much that is original either in substance or interpretation. It is a compilation which many who are interested in the geology and mineral resources of South Africa will greatly appreciate, and of which its author may be justly proud. C G C

### Short Reviews

*The Study of Rocks* By Prof S J Shand Pp xi + 224 (London Thomas Murby and Co., New York D Van Nostrand Co., 1931) 6s net

PROF SHAND has written a clear and well-proportioned account of modern petrography, which instructs the beginner along sound lines and is well worth reading by mature students. Nearly two-thirds of the book is devoted to igneous rocks, and both in this section and in those dealing with the sedimentary and metamorphic rocks, the treatment of rock-forming minerals, and classification, reveals the author's remarkable capability for adequate summarisation.

Chap. IV, on the classification of eruptive rocks, is a masterly outline of the chief systems that have been proposed from the time of Zirkel onwards, culminating in Shand's own scheme as recently developed in his larger book on "Eruptive Rocks." The difficulty of dealing with rocks that carry both quartz and olivine is met by suggesting that if there is enough quartz to convert all the olivine into pyroxene "the rock should then be considered a saturated one." A welcome feature is the recognition that there are peridotites which are definitely intrusive on their own account and seem to owe nothing to accumulation of early formed crystals from basaltic magma.

Sedimentary rocks are divided into (a) organic residues, (b) solution residues, (c) crystalline

rock-residues and (d) crypto-crystalline and colloidal rock-residues. The main classes of metamorphic rocks recognised are mylonites, hornstones, and crystalline schists, granulites and injection-gneisses are referred to under the third of these categories.

Each chapter is followed by suggestions for reading which provide a useful guide to petrological literature. The book is a model of competent compression, and should prove to be a stimulating introduction to this vast and ever-growing subject.

*The Primitive Mind and Modern Civilization* By C R Aldrich (International Library of Psychology, Philosophy and Scientific Method) Pp xvii + 249 (London Kegan Paul and Co. Ltd., New York Harcourt, Brace and Co., 1931) 12s 6d net

EARLY excursions of the psycho-analysts into the realms of anthropology did not produce any results which inspired confidence. Prof Malinowski had no difficulty in showing in his well-known examination of the hypothesis of the father-son antagonism, in the light of the customs of a matrilineal society such as the Trobrianders, that they had failed to take actual conditions into account. Mr Aldrich, a follower of the Zurich school, however, maintaining that anthropology is unable to handle its data unaided, now examines the beliefs and rituals of primitive and savage society in the light of the two principles of the 'racial unconscious' and the gregarious instinct. He attacks the school of Lévy-Bruhl and shows that, so far from the savage standing at a prelogical stage, between which and the thought processes of the civilised mind a gulf is fixed, there is in fact a regular progression from the unconscious, as manifested in an instinct for co-operation, through the conventional morality of the savage and civilised, to the consciously directed social co-operation which is now making itself manifest in certain individual members of society as the place of conventional morality is taken by what he calls 'bio-morality.'

Anthropologists will welcome Mr Aldrich's critical examination of their data, even if they do not agree with his stimulating conclusions. His 'racial unconscious' is at present no more than hypothetical. Its existence still has to be proved. At present his interpretation of social phenomena, such as reasons for purification of warriors on their return from a successful raid, is metaphysical rather than psychological, but it cannot be ignored and will stimulate further research.

*The Life of the Ant* By Maurice Maeterlinck Translated by Bernard Miall Pp 192 (London, New York, Toronto and Melbourne Cassell and Co., Ltd., 1930) 6s net

THIS book completes the author's trilogy—"Lives" of the bee and the white ant being already well-known works from his pen. Much personal observation has been drawn on for the compilation of this volume, and scarcely a page passes without reference to a prominent myrmecologist, whose views are freely discussed. We read of the habits of ants, their social sense, their community

foundation, their adaptability, and their warfare. But so complicated and so biologically big is this communal life that the author appears really to be "writing not the history of a community but the chronicles of a hundred nations."

Ants probably began as insect hunters, and from this predatory life they evolved through the pastoral to the agricultural method of life, thus affording a parallel to the three stages of human history—conquest, defence, industry. What is the secret of this wonderful evolution? We are told that it is rooted in the capacity to live in social communities, and with this capacity has developed a 'mob intelligence' far surpassing that of the individual. Social organisms are endowed with a social organ. For man it is the brain, while for the ant it is a stomach sac used for food storage, and from which regurgitation takes place in response to a caress—that touch of Nature which makes the whole world kin. Their powers of communication—the author suggests the power of speech—and of orientation have been the subjects of research for many naturalists. These powers are seated in the antennae, organs largely concerned with olfaction, but also, we are told, they are endowed with electric, magnetic, etheric, and psychic perceptive ability. The general point of view is distinctly anthropomorphic. The book is delightfully written and beautifully translated.

*The Electrical Equipment of Automobiles a Book on Principles for Motor Mechanics and Motorists* By Prof S P Smith. Second edition, revised and enlarged. Pp xii+198 (London Chapman and Hall, Ltd, 1931) 5s net.

THIS excellent little book, the outcome of lectures given by Prof Smith at the Royal Technical College, Glasgow, contains just what is required by the motorist who has an elementary knowledge of electricity and wishes to understand the electrical equipment of his car. Its seven chapters deal with the storage battery, the action of electrical machines, the starting motor and the dynamotor, the charging generator and the automatic cut-out, miscellaneous electric equipment, wiring systems and location of faults, and the ignition system.

Explanations in simple language are given of the principles and construction of the various equipments, their action is explained, hints as to their proper use are given, and the likely faults are tabulated, together with the appropriate methods of detecting and remedying them. A study of the book will go far towards heightening the interest of the motorist in the many ingenious pieces of apparatus which discovery and invention have placed at his service.

*Introduction à la géométrie projective différentielle des surfaces* Par Prof Guido Fubini et Prof Eduard Čech. Pp vi+291 (Paris Gauthier-Villars et Cie, 1931) 60 francs.

ALTHOUGH the metrical part of differential geometry has been studied for two hundred years, the projective aspect received little attention until much later. Perhaps the earliest work on the subject was that of G H Halphen in 1875, but the

systematic investigation of the projective differential geometry of surfaces was commenced by Wilczynski about 1906. Since then a great deal has been done, especially in Italy and the United States.

A good account of the history and present state of knowledge is given in the book under review, the authors of which have themselves published many researches in the subject. After an introductory chapter there follow two chapters on curves in the plane and in space. The remaining eleven chapters deal chiefly with surfaces, including an account of Cartan's methods. In addition to historical and bibliographical notes at the end of nearly every chapter, there is an extensive list of research papers, occupying thirty-four pages. It is regrettable to find that among all these papers there is only one by an English author. Possibly this book and the larger Italian treatise in two volumes by the same authors will stimulate the study of projective differential geometry in Great Britain.

H T H P

*Problems in Practical Physical Chemistry* By F A Philbrick (Dent's Modern Science Series) Pp xiii+146 (London and Toronto J M Dent and Sons, Ltd, 1931) 3s 6d.

MR PHILBRICK'S book is a joint product of the Oxford school of physical chemistry and of teaching experience at Clifton. In the narrow compass of 146 pages, and at a very modest price, it includes instructions for 33 problems, on reactions, ionic equilibrium, the phase rule, distribution, reaction velocity, electrical conductivity, and indicators. One obvious merit of the book is that a number of exercises in volumetric analysis are set in the form of a physico-chemical problem instead of a mere exercise in analysis, since the student is required to find out the nature of the interaction in question. This procedure not only provides useful experience of chemical methods, but is also a very welcome relief from the too highly standardised exercises which have done duty for a generation in practical courses of physical chemistry.

*Villages et Kasbas berbères tableaux de la vie sociale des Berbères sédentaires dans le sud du Maroc.* Par R. Montagne. Pp ix+22+iv+73 planches (Paris Félix Alcan, 1930) 50 francs.

IN this volume, Dr Robert Montagne has given his readers, literally, a panorama of social development in Morocco according to his interpretation of certain aspects of material culture. The text is reduced to a minimum, the information is conveyed by a series of excellent photographs. In these are shown the different types of villages, fortified and unfortified dwellings, granaries, hill-forts, and structures of a like character, each of which is regarded as appropriate to some phase of the history of the country, ranging from the small independent agricultural community to centralised government through the agency of local governors or tributary chief. The photographs are arranged in groups accordingly, each group being preceded by a brief general account of the social phase it illustrates.

## Electron Optics.\*

By Prof G P THOMSON, F R S

ALMOST all progress in physics has come from comparing the unfamiliar with the familiar. One could scarcely have a better example than the story of Newton's apple—for this comparison assimilated the motion of the moon to the motion of a falling body. The great essential is to use an idea with which one is already familiar. It is less important that the idea should be really understood—if, indeed, anything in the physical world ever can be understood in any absolute sense. The falling of the apple was not understood then (one may perhaps doubt if we understand it much better now, when we say that it is a consequence of the curvature of space), but it was at least familiar, and the mind needs familiar images with which to work.

Now, in the study of the very small there are two pictures which have proved their use. One is as old as the Greeks—the idea of a particle, hard, small, smooth, an idealised grain of sand. Generally it is pictured as moving, and the universe as an endless game of snooker with every ball played at once. The other view is only seven years old, but it is a promising youngster and in the last few years has come to take an equal place with its elder brother, so producing a curious duality in our views of matter. I refer to the idea of matter as waves, which was invented by Louis de Broglie. Now, light has long been regarded as waves, and to many physicists, at least, waves of light are more familiar in their properties than the more tangible waves of water or of sound. This analogy between matter and light is a good one, but, like all analogies, there are points at which it fails.

According to de Broglie, any piece of matter should have wave properties, but in most cases the wave-length would be too small to detect, even with the most refined experiments. The heavier the piece of matter and the faster it is moving, the shorter is the wave-length, and although recently the wave properties of atoms as a whole have been detected, most of the experimental work has been done with the lightest known pieces of matter, namely, electrons. Even with these, the wave-length is usually much less than that of light. Thus for the electrons which form part of a beam of cathode rays from a discharge in rarefied air, the wave-length is usually about one fortieth of the size of an average atom, and only about one hundred-thousandth of the wave-length of red light. Actually, if the voltage is 30,000 volts, the wave-length is about  $7 \times 10^{-10}$  cm.

The characteristic feature of those waves which one can actually see and feel is the periodic motion of the water or other medium, but when one comes to waves in which one can no longer actually see the medium bobbing up and down, the most characteristic wave property is that called 'interference'. This is the property by which, for example, two beams of light can produce darkness, and is explained at once as due to the superposition of two

trains of waves in such a way that the crest of one wave neutralises the trough of another.

In the case of light, this leads to a pattern of light and dark bands, the sharpness of which may be much increased by using not two waves only but a large number of wavelets produced by the scattering of a single wave from a number of obstacles arranged in a regular order. To get a satisfactory pattern, the distance apart of the scattering objects must not be too great compared with the wave-length of the light. This led Laue to use the atoms of a crystal as scattering centres to measure the very short wave-length of X-rays. The use of a crystal, however, introduces a complication, for we are not only concerned with the wavelets from one plane of atoms but also with those from successive planes. The result is that only if the crystal is correctly adjusted to the incident beam will there be a strong beam selected by interference. If the crystal is powdered and the pieces are arranged at random in the path of the rays, there will always be some pieces correctly adjusted, and the beams from them will lie on cones and their intersection with a screen will show as rings. The absolute sizes of the rings are proportional to the wave-length and inversely as the spacing of the atoms, while the relative sizes of the different rings in any one experiment depend on the arrangement of the atoms in the crystal.

Now, electrons are certainly scattered by atoms. If they are like waves, they should give interference and the scattered waves should be concentrated in certain directions, presumably the electrons will show themselves most where the waves are concentrated. In my early experiments, this was done by passing a narrow beam of cathode rays through a thin foil and receiving the scattered rays on a photographic plate. When developed, these plates showed ring patterns which were in agreement with those calculated from de Broglie's theory and the known crystal structure of the metal films used. To get good results the films had to be of the order of  $10^{-6}$  cm, and this limits the substances with which one can work. I have found, however, that equally good results can be got by reflecting the rays from a block of material, the face of which has been suitably prepared. It is probable that the rays pass through minute projections on the surface, so that the reflection is only apparent. In this way ring patterns have been obtained with a variety of substances, such, for example, as spluttered metals and metals which have undergone surface oxidation or other chemical change. The method enables one to examine a very thin layer of the substance, for the effective depth of penetration is of the order  $10^{-6}$  cm. It appears that almost any surface will give some kind of a pattern, providing that it is reasonably flat.

The concentration due to interference is, as we have seen, much more marked if there are many scattering centres arranged in order. This is so in

\* Friday evening discourse delivered at the Royal Institution on Dec 4

the case of the above experiments, for though the crystals are small enough to be very numerous, even in a small piece of material, they each contain a very large number of atoms. Recently, Wierl has made experiments of the same character with gases. Here the scattering particles are the atoms, of which there are only a few in each molecule, so though rings are formed, they are not very sharp. Nevertheless, the theory holds, and Wierl has calculated the distance apart of the atoms in various molecules from the sizes of the rings. He has been able to draw a number of interesting conclusions about the relative positions of the atoms in the molecules. For example, he finds that the carbon atoms in the benzene rings lie in a plane. Mr French has recently found similar diffuse rings from the polished surfaces of metals. These rings appear to be due to the noncrystalline Beilby layer.

The apparatus I have described will also serve for single crystals. Here, however, we should expect nothing unless the crystal were suitably adjusted, and then only a small number of spots. With a cleaved surface of rock salt these expectations are approximately fulfilled, though there is enough latitude from various causes for some sort of a spot to appear for almost any setting of the crystal. In addition, there appear a number of black and white lines, which have been ably explained by the discoverer, Kikuchi, as due to double scattering.

Some experiments with single crystals of metals have led to rather surprising results. When cut so that the face is crystallographically a simple one, these crystals give an extended pattern of spots of a very regular character. The pattern is just what we expect from a single layer of atoms arranged in the crystal form and set normal to the rays. The agreement is exact and extends to small details. The pattern is the polar reciprocal of the atomic arrangement known to exist in the crystal, each spot of the pattern corresponds to a line of atoms in the crystal, and the whole plane of atoms behaves like two crossed optical gratings. Clearly, however, a single plane of atoms sticking out at right angles to the main surface is a mechanical impossibility. The surface was actually prepared by etching and was probably covered with pits and pyramids, through which the electrons pass. The reason for the extended pattern is that the thickness in the path of the rays is so small that the successive layers of atoms are not badly out of step over a considerable range of angle. This approximate agreement is helped by the small angle through which the rays are turned out.

Some recent work in conjunction with Mr Stuart on spluttered platinum films has shown that while the usual structure is that of normal platinum, abnormal types sometimes occur. One of these gives a pattern of straight lines, which is unstable and disappears under the action of the rays. It appears to be due to the presence on the surface of small pieces of some crystalline structure in which the atoms are arranged accurately in layers parallel to the surface but each separate layer is largely chaotic. We have not been able to determine whether the atoms are those of platinum or of a

gas. Another abnormal structure shows the presence of extra rings, which may be associated with catalytic activity of the platinum.

While these experiments show the close resemblance between the behaviour of the electrons and that of light in those experiments which were the original proof of its wave character, yet, all the same, one must not entirely abandon the particle idea. When the electron reaches the photographic plate, it seems to forget that it is a wave and becomes a particle. If the plate were examined under a high magnification, the pattern would show up as a number of black specks, each corresponding to one



FIG. 1.—Diffraction pattern formed by electrons reflected from a cube face of a silver crystal. The interrupted line was added afterwards.

grain of silver bromide made developable. Each electron affects one grain only. Yet the waves which interfere must have been scattered from atoms over a wide front, and the sharpness of the ring and spots shows that there has been a long train of waves acting, just as a sharp line in an optical spectrum implies a long train of coherent waves. On the wave side of its nature the electron is a widely extended entity which in a sense occupies the whole region in which it might be found. An electron is like an able guerilla leader who occupies a wide area with rumours of his presence, but when he strikes, he strikes with his whole force. No analogy is perfect, and though the analogy between light and electrons even extends to this curious duality of wave and particle, it breaks down in the end.

Electrons are essentially different from light. They are acted on by electric and magnetic forces, and react on the bodies which cause these forces. Light does not—it only affects matter when it actually hits it, there is no action at a distance. Further, the electronic waves are a trifle less real than those of light. No one, it is true, has ever actually observed the frequency of visible light, but that of very long wireless waves can be directly followed, and the difference must be only one of degree. Now, so far as we know at present, the frequency of electron waves is quite unobservable. It is always the wave-length which we find. Possibly we could observe differences of frequency under

very special conditions, but the absolute values seem to have no significance except as mathematical symbols. Different values can be assigned to this frequency, and the calculated results still agree with experiment.

Again, the fluctuating quantities or 'displacements' in the light wave have a definite physical meaning, namely, electric and magnetic intensities. No one has observed the corresponding quantity in the electronic wave. Indeed, in the most suc-

cessful forms of the theory it is not even a real number. Only the intensity of the wave has a physical meaning, namely, the chance that an electron will appear at the place in question. The two views of electrons, as particle and as wave, are parables, each enshrining a part of the truth. Whether between them they include all that we need to know, as some physicists believe, or whether there are not other aspects, still undreamed of, is for the future to decide.

### Dental Caries and Diet.

THE researches of Mrs Mellanby on the part played by diet in the development of the teeth and jaws in animals have already been referred to in these columns<sup>1</sup>. A report on the relationship between diet and the structure of human teeth is in course of preparation. Mrs Mellanby's work has also led to the conclusion that it is possible to influence the structure, and thereby the resistance to disease, of teeth after eruption. It was obviously desirable that this conclusion should be confirmed by a large-scale clinical trial. A preliminary report of such a trial has now been issued by the Committee upon Dental Disease<sup>2</sup>.

The investigation was carried out at three residential institutions for children near Birmingham, under the control of the poor law and later the local education authority. The teeth of the children were examined every six months by Mr A Deverall; the diets were controlled by Miss E Brinton and Miss M Reynolds. The number of children included in the investigation was 332, aged from 5 years to 14 years; the duration of the test was two years. The children were divided into four groups, all of which were on a similar and generous basal diet. At the first institution 1-1 5 oz treacle daily was added to the diet, at the second 1-1 5 tablespoonfuls (14-21 c c) daily of olive oil to that of one group and a similar amount of olive oil containing radiostol (irradiated ergosterol) to that of the remaining children, at the third institution the addition to the diet was 14-21 c c cod-liver oil daily.

The dental examination made at each inspection included the number and structure of the fully erupted teeth, the condition as regards caries, of which three degrees were arbitrarily recognised, and the condition of the gums. By using a numerical notation for the degree of caries, it was possible to obtain the total caries figure for any group of children, and also the average caries figure by dividing the total by the number of teeth in the group. All teeth lost subsequent to the first inspection continued to be counted in later inspections, since otherwise the extraction of a carious tooth would appear to lead to a sudden improvement in the condition as regards caries. The incidence of caries in a group was shown by the number of carious teeth; the extent of caries by the average caries figure. The latter could only show a decrease when the number of teeth in the group increased by the eruption of fresh teeth, which were not attacked,

or only slightly, by caries, since the total caries figure could not decrease with the passage of time.

The investigation reported was actually carried out in two parts: in the first the effects of adding treacle, olive oil, or cod-liver oil to the diet were compared, in the second the effects of olive oil and radiostol. The olive oil group was to a large extent the same in each investigation. Each group consisted of 65-85 children. The results obtained were briefly as follows: the increase in the percentage of carious teeth in the group given treacle was 10, in those given olive oil 8, and cod-liver oil 3, in the first experiment, in the second the olive oil group showed a percentage increase of 7 and the radiostol group one of 2. The percentage increases of the average caries figures for the five groups were respectively 42, 46, 10, 31, and 10. Statistically, all the differences are significant except that between the average caries figures in the second experiment. Further analysis of the figures indicated that similar differences were observed when the deciduous teeth, the permanent teeth or the first and second premolars (upper and lower), or first permanent molars (upper and lower), were considered separately. In the first investigation the actual number of carious teeth approximately doubled at the institutions in which treacle and olive oil were the dietary supplements, but only increased 50 per cent when cod-liver oil was given. In the second investigation the number of carious teeth per child rose from 4.5 to 6.2 in the radiostol group and from 3.8 to 6.4 in the control group, for the permanent teeth the figures were 1.8-3.1 and 1.6-3.7 respectively. Very similar figures were obtained in the first experiment.

Considering the two investigations together, it was found that the increase of the average caries figure of the permanent teeth in the two vitamin groups was about two-fifths of that in the control groups. In general, the results agreed closely with those previously obtained at Sheffield with a smaller number of younger children suffering from surgical tuberculosis and showing a higher initial incidence of caries.

It appears, therefore, that the addition of vitamin D to a standard dietary will reduce the increase in the incidence and extent of caries, which occurs with the passage of time, by about two-thirds.

<sup>1</sup> NATURE, vol 125, p 604, 1930 vol 127, p 977, 1931

<sup>2</sup> "The Influence of Diet on Caries in Children's Teeth" (Interim Report) By the Committee upon Dental Disease. Medical Research Council Special Report Series No 159 (London: H.M. Stationery Office, 1931) 6d net

## Obituary.

MAJOR-GENERAL SIR DAVID BRUCE,  
K C B, F R S

SIR DAVID BRUCE was one of the greatest of the great physicians who deal less in healing of the sick than in the conquest and abolition of disease, he died of a dread disease on Nov 27, in the seventy-seventh year of his age. His one fear had lately been lest his wife, the comrade of fifty arduous years, should be left helpless, but her release from suffering came four days before his own.

Born in Melbourne (on May 29, 1855) but brought home to Scotland at five years old, Bruce went to Stirling High School, and was sent out into the world, by way of a Manchester warehouse, at the age of fourteen. There he worked for about three years, during which time his wish was to become a professional boxer or footballer, an ambition which those can understand who remember his great figure and his prodigious strength when he was young. About the year 1876-77 he came to the University of Edinburgh and began to study medicine, soon afterwards he was foremost in a little band of friends, of whom Diarmid Noel Paton the physiologist was one, and another helps to-day to write these words. We worked together, fifty-three years ago, at the same table in Turner's old dissecting-room, the ways and appurtenances of which had scarcely changed in two hundred years, and then stepped across the street to see Lister turn up the cuffs of his black frock-coat, and operate under the spray.

Immediately after graduating, Bruce joined the Army Medical Service in 1883, and in the same year he married Mary Elizabeth Steele, a doctor's daughter, of Reigate. The marriage was singularly fortunate. Mary Bruce was a rare helpmeet, tireless and fearless, ready at any moment to follow her husband across the world, growing more and more skilled in all the delicate manipulations of bacteriology, and possessed of no little scientific insight and acumen of her own. Bruce was never tired of praising her, of acknowledging her help, of testifying to her knowledge and ability. Almost his last words were to remind a friend that the story of his own life was never to be told without full credit being paid to Mary for her part therein.

Bruce was a fervid admirer of Pasteur, all his life long. It was Pasteur's example which he followed steadily, to make of medicine "an experimental biological science", and to arrive at "the intelligent, purposive prevention of disease". Pasteur's epoch-making work was already something of an old story when Bruce was a student, but another great epoch was just beginning, with Laveran's discovery of the malaria parasite in the blood corpuscles, and with Koch's discovery of the tubercle bacillus.

In Bruce's presidential address to the British Association at Toronto—an address which seemed to relate every salient fact of modern medicine within the brief compass of an hour—he tells how one day in 1882, in Edinburgh, he heard of Koch's

great discovery from a fellow-student just home from Germany. So revolutionary an idea was hard to believe at first, but Bruce sketches the interest and excitement it aroused, in which he shared to the full. The excitement continued for within two years more the bacilli of glanders, diphtheria, typhoid, and cholera had all been discovered in Koch's laboratory. By this time, in 1884, Bruce—an Army surgeon and a married man—was at work in Malta, and so well did he follow Koch's and Pasteur's example that by 1886 he had discovered *Micrococcus* (now *Brucella*) *melitensis*, and proved it to be the actual cause of Malta (or Mediterranean) fever. This was a cardinal discovery. The bacteriologist of to-day, with his well-stocked laboratory and the experience of fifty years behind him, may well pay tribute to Bruce's splendid insight, which let him see how, by cultivation of a micro-organism from a patient's blood, evidence could be got of the direct relation between the organism and the disease. Bruce went straight to the root of the matter, and his method of blood-culture, a commonplace of to-day, was a pioneer procedure then. The work was done against almost insuperable technical difficulties, the observations were repeated again and yet again. At last, after many disappointments and set-backs, Bruce succeeded in reproducing the disease among his experimental animals.

The discovery of the causal agent of a communicable disease often helps but little towards the finding of means for its prevention, but in this case Bruce's indomitable energy had its ultimate reward. For seventeen years after the discovery of *M. melitensis*, Malta fever continued to prevail. "Almost every sailor who came into hospital even for the most trivial complaint took Malta fever, and after a long illness had to be invalided home." At last the Admiralty and the War Office took alarm, and Bruce was sent out again by the Royal Society, in 1904, at the head of a Commission. After months of hard and disappointing work, Dr Zammit, a Maltese colleague, happened to examine the blood of a goat—an animal which had been already and repeatedly found immune to the disease, but now it turned out that the goat's blood 'agglutinated' or 'clumped' the micrococcus—a fact which Bruce took to mean that the organism must have been living and multiplying within the apparently healthy goat before this peculiar property of its blood could be brought about. Work went on with new hope and energy, fifty per cent of the island goats were found to carry the micrococcus, and a fifth part of these were actually passing it into their milk. Maltese milk was at once struck out of the dietary, and "from that day to this", said Bruce, "there has scarcely been a case of Malta fever in the garrison. The disease had been blotted out at a single blow." This conquest of Malta fever is one of the greatest, most unequivocal successes of preventive medicine.

In 1894, Bruce began his long study of the



trypanosomes, and the story of his investigation of these, and of the diseases of man and beast which are associated with them, is the chief story of his life. In 1895, a severe epidemic of nagana among the native cattle of northern Zululand was reported to the Natal government. Bruce happened to be stationed in Natal, and Sir W. Hely-Hutchinson, the governor, a wise and friendly man, put the task of investigation into his hands. So Bruce and Mary started off on their long trek by ox-wagon to the scene of the outbreak, and the first thing they did was to discover trypanosomes in the blood of the infected animals. Bruce was a first-class naturalist, he had learned the art of outdoor observation on the Ochils as a schoolboy, and on the Grampians in his college years, and his next step, after discovering trypanosomes in the infected blood, was the work of the naturalist rather than of the physician. There happened to be a 'fly-belt' hard by Bruce's camp, between the high ground and the sea, and Bruce, knowing (as every Scotch boy did) all that David Livingstone had to tell about the tsetse fly, took it into his head to see what actually happened when a beast was bitten by the fly. Natives were told to drive their cattle into the fly-belt, and when they came home it was with no little surprise that Bruce found the blood of the fly-struck animals to contain the nagana parasite. But the natural history of the case was not yet all told. The next thing was to seek and to find the same trypanosome living, but living harmlessly, in the wild game of the country—in antelope and buffaloes, which had become, like the Maltese goats, immune to the disease. Bruce had to do all this work with the most primitive appliances, but he surmounted every difficulty. At last, not only was the specific trypanosome (*T. brucei*) of nagana discovered and its relation to the disease established, but the precise way in which *Glossina morsitans* propagated the disease was made clear. This was the first demonstration of the transmission by an insect of any protozoal disease. It won for Bruce his fellowship of the Royal Society in 1899.

It had needed keen insight and a wide outlook to discern how the wild game of the region might act as a reservoir of infection, and it took a deal of hard work to prove that it did so. Later on, when Bruce came to study sleeping sickness in mankind, the lesson so learned of the possibility, or probability, of the malady lurking continually among the huge herds of wild animals must have seemed to him, lover of animals as he was, an appalling problem.

In 1903, not long after the Boer War was over, Bruce, together with his wife and Dr. David Nabarro, went out to Uganda (again at the instance of the Royal Society) to continue and extend Castellani's work on sleeping sickness, done in the year before. The needful clues were now all in Bruce's hand. He knew that trypanosomes had been found in the cerebro-spinal fluid of sufferers from the disease, and his experience told him that the infection was most likely due to a blood-sucking fly, probably to one of the *Glossina* species. How he showed that the area occupied by *Gl. palpalis* and

that infested by sleeping sickness were one and the same, is a romance of science.

Bruce was walking through the forest paths one day with the king of the country, telling him about the fly and its effects, and explaining how useful it would be to know just where the fly lived and how far its range extended. The king listened with great attention, then whispered to his viziers, who in turn slipped one by one from the pathway into the bush. Here on either side, silent and unseen, were the king's attendant messengers, and before Bruce had come to an end of his story these men had set off to all parts of the country, with the king's command that the tsetse flies should be sought for, and brought in from wheresoever they should be found. It was a triumph of organisation, and the dusky king shares the credit with the investigator, it was also a complete scientific success. The remarkable fact had already been discovered that the disease kept to the islands and to a narrow belt of country by the shore of the lake, in no part of Uganda were cases found more than a few miles from the lake shore. It was now shown that the distribution of the disease was identical with that of the tsetse fly, where there was no fly, there was no sleeping sickness.

Bruce came home in the autumn of the same year, 1903, but went out to Uganda again five years later, in order to work at the life of the parasite within its insect-host. He found out, among other things—and it must have been a sad disappointment to him—that many animals can harbour *Trypanosoma gambiense* over long periods, a fact which could only mean that the prevention of sleeping sickness was a well-nigh insoluble problem. He found also that *Gl. palpalis* was the insect-host, or 'vector', not only of *Tr. gambiense*, but also of sundry other trypanosomes besides, and his careful descriptions of these species, and their varying behaviour within the insect-host, were very helpful to the next workers in the field. His last work on this subject was done in Nyasaland, between 1911 and 1914, as head of a commission on trypanosome infections of man and animals in that territory. He came to the conclusion that the human trypanosome of Nyasaland was not identical with *T. brucei* though its vector was *Gl. morsitans*. It is perhaps still an open question whether this trypanosome (commonly called *Tr. rhodesiense*) and *T. gambiense* may not both of them be mere varieties of Bruce's own nagana trypanosome, *T. brucei*. Bruce showed often in his later talk how glad he would have been to go out once more, to solve this final problem.

There is far more to tell of Bruce's great and crowded life than can be told here. Happening to be in Ladysmith during the siege, he turned his hand to surgery, with conspicuous success, and with such love and devotion did he sometimes speak of this part of his life that one felt that a great surgeon had perhaps been lost to make a still greater scientist. His wife became a nurse at the same time, and stood beside her husband in his tireless labours, she earned the Royal Red Cross thereby.

Soon after the beginning of the War in 1914, tetanus made its appearance among the wounded, in so alarming a way that no time had to be lost in grappling with the danger, among many thousand wounded (however slight their injuries might be) some 9 or 10 per cent were attacked by tetanus, and no less than 85 per cent of all those affected died. A committee was appointed in haste, with Bruce at its head, and this committee made the crucial discovery that if the appropriate serum (Kitasato's famous *antitoxin*) be administered *at once*, the wound will lead to no lockjaw symptoms. As Bruce put it, there were 2500 cases of lockjaw in the British Army during the War, and 550 deaths, there would have been 25 000 cases and 20,000 deaths, had matters been allowed to go on as they were during the first months of the War, without the prophylactic serum injections.

During the War, Bruce was Commandant of the Royal Medical College, where his knowledge and immense experience were put to good use in controlling the many varied and even divergent activities of that place. He became chairman of a War Office Committee on Trench Fever, as he had been before of that on tetanus, and once more his driving power and his own industry helped and hastened the investigation. Doubtless a large part of the work was done in this case by others, but the success was just as complete as in the other cases where Bruce worked alone. It was amply proved that the louse, and the louse alone, was to blame for spreading the disease, and (as Bruce said in his Toronto address) this meant that very soon trench fever would have been abolished on the western front. In 1917 it had been the cause of some 20,000 out of a total of 100,000 admissions to hospital in the British Second Army alone.

Besides his scientific work, Bruce played many lesser but important parts. He was president of the Physiological Section of the British Association at the South African meeting in 1905, and president of the Association at Toronto in 1924. He was president of the Royal Society of Tropical Medicine from 1917 to 1919, editor of the *Journal of the R A M C* from 1904 to 1908, Croonian lecturer at the College of Physicians in 1915, and chairman of the governing body of the Lister Institute from 1916 until his death. Honours came to him in their course, and he wore them proudly, as a soldier should, but at heart he was always the humble student, and the untiring friend and helper of younger men.

Bruce's scientific imagination and intuition were as fine as the simplicity of his heart. He had had little of what we understand by laboratory teaching, little or no apprenticeship to research, in Edinburgh fifty years ago, but he had Lister's great example constantly before him, and Pasteur's to think of, and Koch's to learn of later on. He needed no more than these, and his own brains, to enable him to attack the problems which presently faced him, with all the skilled assurance of a master-hand. He had the gift which belongs to the greatest of scientific men, the true Faraday gift, of putting plain questions to

Nature never two at one time, and always such as she can answer in simple words. His imagination kept him always one step ahead of his observations, his judgment told him where that step should be, energy spurred him on, and the shrewdest common-sense held him back from unsafe conclusions. He took no regard of riches, he was contented to be poor, but his face was set like flint towards his one ambition, the victory over disease.

Those who knew Bruce best found him stern but most lovable, *sans peur et sans reproche*. His heart went out to all those in sorrow, need, or sickness. He closed his Toronto address with solemn words: "We are all children of one Father. The advance of our knowledge of disease is not for the benefit of one country but for all—for the lonely African native, deserted by his tribe, dying of sleeping sickness in the jungle, or the Indian or Chinese coolie dying miserably of beri-beri, just as much as for the citizens of our own towns."

"It is the duty of science", he said (it was his own rule of life), "to go steadily forward, illuminating the dark places in hope of happier times." He never turned aside or knew discouragement. "On, on, and no regrets", was a phrase he often used, it had been his own watchword, and he passed it on, to be a warning and an encouragement to men who had their lives to live.

Bruce died poor and sorely stricken, he had had his troubles and perplexities withal. But he had also (like Greatheart in the story) had the golden hours when great things happen, and they had brought him the supreme reward of triumphant and beneficent discovery.

D W T  
W J T

THOUGH David Bruce, whose recent death removes from the field of tropical medical research one of its most brilliant investigators, made discoveries of the utmost importance in connexion with Malta fever, for which he was elected a fellow of the Royal Society in 1899, his name will ever be associated with Africa, that dark continent where mysterious and dread diseases of both man and animals had brought ruin to expeditions of explorers and loss of hope and too often death to those attempting its development. Malaria and black-water fever, yellow fever and sleeping sickness took their toll of human lives, while tsetse fly disease or nagana and other obscure maladies wrought havoc amongst the domestic stocks, frequently wiping out in a few days the entire animal transport of some luckless adventurer. It is for his work on two of these diseases, nagana and sleeping sickness, that David Bruce attained his world-wide reputation.

Having been sent to South Africa in 1894 from the post of assistant professor of pathology at Netley, Bruce was requested by the Governor of Natal in 1895 to proceed to Zululand to investigate an outbreak of nagana amongst the cattle. Arriving at Umbobo after an arduous journey, any weaker man would have regarded the usual wattle and daub hut provided for living-room and laboratory as quite inadequate accommodation, not so David Bruce, who, with his courageous and gifted

wife, began that long series of researches the results of which have served as the foundation of all work on trypanosomiasis. His reports are models of what such reports should be, and display a logical sequence and an inductive reasoning which are remarkable. Published for the most part in the *Proceedings of the Royal Society*, they are brief and concise statements of the experiments and observations and the results obtained, the one following the other in such order and leading so inevitably towards the goal that one feels there must have been, as Col Hamerton has written, "an undefinable intuition almost mystical in its working".

Shortly after reaching Umbobo, Bruce discovered in the blood of sick animals a trypanosome similar to the one seen by Timothy Lewis in rats in India in 1878 and by Griffith Evans in 1880 in horses and camels suffering from surra in the same country. He demonstrated the pathogenicity of this organism, its transmission by tsetse flies, and its occurrence in the game, which appeared to harbour it without injury to themselves and to be mere reservoirs. In 1896 he sent to England a dog infected with the trypanosome, which was investigated by Plimmer and Bradford, and named *Trypanosoma brucei* in honour of its discoverer. This strain, handed on to other laboratories, was the starting-point of a long series of important investigations. On his work in Zululand, Bruce published a Preliminary Report in 1895, a Further Report in 1897, and an Appendix to the Further Report in 1903. His work was interrupted by the South African War, during which he distinguished himself at the siege of Ladysmith.

In 1902 the Royal Society had sent to Uganda a Commission to study sleeping sickness, and Bruce was requested to take charge at the beginning of 1903. Again accompanied by his wife, he went to Entebbe, where he was informed by Castellani, a member of the Commission who was on the point of leaving for England, of his discovery at the end of 1902 of trypanosomes in the cerebro-spinal fluid of sleeping sickness cases. Further investigation during the remaining three weeks of Castellani's stay showed that the trypanosome could be found in a large percentage of the cases, and it was quickly realised that it was the causative organism. Experiments with the tsetse fly, *Glossina palpalis*, allied to *Glossina morsitans* (or *Glossina pallidipes*), with which he had worked at Umbobo, enabled Bruce to demonstrate that it was the vector of the trypanosome, which proved to be *Trypanosoma gambiense*, described by Dutton in 1902 from the blood of an Englishman who was suffering from fever after having spent six years in the Gambia.

Bruce returned to England towards the end of 1903 and was occupied with other work until 1908, when he returned to Uganda to continue his investigation of sleeping sickness. Though, working with tsetse flies captured in the open, he had effected transmission of the trypanosomes of nagana and sleeping sickness, he adhered to the view that this was a mechanical process, the tsetse fly carrying on its proboscis infective blood for a comparatively

short time. Kleine, working with tsetse flies raised from pupæ, was able to demonstrate in 1909 that, fed on infected animals, they quickly lost their power of transmission, but that this was regained after an incubation period of about twenty days. This important discovery was soon confirmed by Bruce, who studied in detail the behaviour of the trypanosome in the tsetse fly and traced its course during the incubation period from the stomach, where it had passed with the ingested blood, back again to the proboscis and thence into the salivary glands, where the flagellate renewed its trypanosome form which it previously lost, and was then, and not until then, infective.

Bruce further studied the trypanosomes of domestic animals and their transmission, and proved that in their case also an incubation period was necessary in the fly, but that the cycle of development was not always the same. The trypanosome of nagana, *Trypanosoma brucei*, had a cycle like that of *Trypanosoma gambiense*, but *Trypanosoma congolense*, referred to by him as *Trypanosoma pecorum*, did not invade the salivary glands but remained in the proboscis after its return from the stomach, while *Trypanosoma vivax* made no return from the stomach, the only forms developing being those which lodged in the proboscis when the fly took up infective blood, the whole development occurring in the proboscis alone. These differences in behaviour in the fly enabled Bruce to classify the pathogenic trypanosomes of Africa in three groups, headed by *Trypanosoma brucei*, *Trypanosoma congolense*, and *Trypanosoma vivax* respectively. The other representative of the first group was *Trypanosoma gambiense*, and those of the other groups allied forms, several of which he had himself discovered.

David Bruce left Uganda in 1910, and in 1913 went to Nyasaland to study *Trypanosoma rhodesiense*, which had been found to produce in man a disease more quickly fatal than sleeping sickness. These studies led him to the conclusion that *Trypanosoma rhodesiense* was no other than *Trypanosoma brucei* of nagana, which was inoculated to domestic animals and occasionally to man by *Glossina morsitans*, a view which was in agreement with that expressed by Kinghorn and Yorke in 1912 from the Luangwa Valley but opposed to that of the great German investigator Kleine, who believed and still believes that *Trypanosoma rhodesiense* and *Trypanosoma brucei* are distinct.

The above account gives but a poor conception of the extent of Bruce's work on trypanosomiasis. It does not deal with the many obstacles and difficulties which his indomitable will was successful in overcoming. It states in briefest outline the main results achieved, each being the outcome of carefully planned experiment and laborious investigation—each trypanosome encountered being subjected to the same exhaustive tests and critical observations. The work of David Bruce in Africa is not only of the highest scientific value but also has a definitely practical bearing in that it has shown the way to the eradication of a group of most serious diseases.

It has already been mentioned that Lady Bruce, who died a few days before him, was his constant companion. No account of the work of David Bruce would be complete, as he himself insisted, without some reference to the important part she played. Being a skilled microscopist and artist, with a practical knowledge of the details of laboratory technique, for which she had a greater patience and aptitude than her husband, she shared the work with him, indeed, to such an extent that it is difficult not to regard David Bruce and his wife as a single unit and to conclude that neither would have achieved success without the other. They worked alone, without help, in Zululand, but on other Commissions were accompanied by various collaborators, whose part in the work was duly acknowledged in the reports and who contributed in no small measure to the success of the expeditions.

C M WENYON

WE regret to announce the sudden death, at his home in Liverpool, of Mr Andrew Scott, on Dec 27, at the age of sixty-three years. Mr Scott had been on the scientific staff of the Lancashire and Western Sea-Fisheries Committee since 1895, and, at the time of his death, was working in the University of Liverpool, mainly on the plankton collections made by the *Discovery* in the Antarctic Ocean. He had a quite remarkable knowledge of Crustacea, and, with his father, the late Dr

Thomas Scott, had described collections of Copepoda from all parts of the world. He is survived by his widow and a son and daughter.

DR JOHANN KIAER, professor of palaeontology in the University of Oslo and head of its Palaeontological Museum, died on Oct 31, at the age of sixty-two years. Dr Kiaer was distinguished for his work on the palaeozoic formations of Norway and Spitsbergen and for his descriptions of their corals, trilobites, and, especially, the Silurian and Devonian fishes. He had often visited Great Britain, where he will be deeply mourned by many friends.

WE regret to announce the following deaths.

Mr James Ford, superintendent of the Radcliffe Science Library, Oxford, on Dec 18, aged seventy-four years.

Dr Edward H Jenkins, formerly director of the Connecticut Agricultural Experiment Station, who carried out important work on the culture, curing, and fermentation of tobacco, on Nov 7, aged eighty-one years.

Prof Olin H Landreth, emeritus professor of engineering in Union College, Schenectady, New York, known for his work in engineering administration and sanitary engineering, on Nov 5, aged seventy-nine years.

## News and Views.

### Isolation of Vitamin A.

FOLLOWING closely on the announcement of the probable preparation of vitamin D by several independent workers (NATURE, Jan 9, p 50), come two announcements of the isolation of a substance which *prima facie* appears to be the long-sought vitamin A. In a paper published in the issue of *Helvetica Chimica Acta* for December 1931, Prof P Karrer, of the University of Zurich, together with R Morf and K Schopp, describes the isolation and purification from the unsaponifiable fraction of the liver oil of the skipper (*Scomberox saurus*) of an alcohol having the formula  $C_{20}H_{30}O$  or  $C_{22}H_{32}O$ , optically inactive, and possessing the molecular weight 300-320. Esters of acetic and *p*-nitrobenzoic acid were prepared, and the alcohol gave geronic acid on oxidation with ozone. The same substance was obtained by a special method from the liver oil of the halibut (*Hippoglossus hippoglossus*). In an address on "Recent Progress in the Chemical Study of Vitamins", given to the London Section of the Society of Chemical Industry on Jan 4, Prof J C Drummond stated that he, in collaboration with Prof I M Heilbron and Dr R A Morton, had succeeded in isolating, by a process of fractional distillation, a very potent fraction from the unsaponifiable residue of the liver oil of the halibut. The substance is a heavy, viscid oil of a slightly yellow colour, it is an alcohol, its formula is probably  $C_{20}H_{30}O$ , and its vitamin potency is of the same order as that of the recently discovered 'calciferol'. Sufficient work has

not yet been done to enable us to say that the substance is pure vitamin A, but it seems very probable that its purity is approximately ninety per cent.

### Ouabain

OUABAIN,  $C_{30}H_{46}O_{12}$ , a crystalline glucoside occurring in the seeds of *Strophanthus gratus* and in the wood of various *Acocanthera* species, was first isolated from *Acocanthera Schumperi* by Arnaud in 1888 and named ouabain, from ouabaic, an arrow poison. It is described in the German Pharmacopoeia (1926) and is included in the United States Pharmacopoeia (1926) for use as a standard for the biological control of preparations of digitalis and strophanthus. It is particularly suited for use as a standard substance, since it is easily purified and the purity is readily ascertained by the ordinary methods of chemical analysis, so that the standard is easily reproducible. Ouabain for use as a biological standard is distributed by the Bureau of Standards in the United States, and has been recommended for use by the League of Nations Health Organisation. As a pure substance it offers decided advantages, and may eventually replace the by no means uniform strophanthin of commerce, which consists of a mixture of glucosides derived from *Strophanthus Kombé*, probably in many cases contaminated with other species not readily distinguishable. Ouabain has not hitherto been readily available commercially, but it has been prepared for a number of years past in the experimental laboratories of Messrs Burroughs

Wellcome and Co for use in the associated research institutions. It has now been put on sale for research purposes and for use in clinical medicine.

#### New Biological Station in Bermuda

A new biological station has been established at Shore Hills, St George's, West, Bermuda. The site for the station and an annual grant for a period of ten years have been provided by the Government of Bermuda, while the Rockefeller Foundation has made a grant of £50,000 for the building and equipment. The station is under the management of an international board of trustees composed of leading biologists of the United States, with representatives of Great Britain and Canada. The president is Prof E G Conklin, and amongst the executive committee and officers are Profs E L Mark, E V Cowdry, C B Davenport, and R G Harrison, and Dr A G Huntsman, the Canadian representative. The two trustees representing Great Britain are Prof J H Ashworth and Dr E J Allen. The station consists of a large building, beautifully situated, with convenient access to the open sea. There is accommodation for a large number of research workers, and every facility will be provided for all kinds of biological work. Dr J F G Wheeler, who, after a training in marine research at the Plymouth Marine Biological Laboratory, became a naturalist on the *Discovery* Expedition and has published important work on whales, has been appointed director, and is now in Bermuda. According to a telegram from the *Times* correspondent in Bermuda, dated Jan 6, Sir Thomas Cubitt, Governor of the Colony, has now formally opened the station. It is to be hoped that many English biologists will take advantage of the unique opportunities which the station offers for research.

#### Association of British Zoologists

A WELL-ATTENDED meeting of British zoologists was held by the Association in the rooms of the Zoological Society of London on Jan 9, with Sir Peter Chalmers Mitchell in the chair. After two papers of technical interest, Mr J T Saunders reported on the institution, at Wray Castle, Windermere, of the laboratory of the Fresh Water Biological Association of the British Empire, and invited visiting naturalists to make use of its facilities for research. Prof E W MacBride pointed out the extreme importance of such research for the purpose of guiding legislation and departmental action on river pollution. Lieut-Col R B Seymour Sewell gave an account of the origin and history of the Zoological Survey of India, and Mr G C Robson urged the need of a comprehensive survey of the fauna of the British Isles. The Council's action in protesting against the curtailment of staff in the Zoological Survey of India was warmly approved by the Association. The Association welcomed the progress made by the Wray Castle laboratory, and agreed with the views expressed of the national and imperial importance of fresh water research, and the immediate need of further help, financial and technical. The meeting requested the Council to examine practical means to be adopted as to the survey of British fauna.

#### Exhibition of Scientific Instruments and Apparatus.

THE catalogue of the twenty-second Annual Exhibition of Scientific Instruments and Apparatus, held at the Imperial College, South Kensington, on Jan 5-7 by the Physical and Optical Societies, is an illustrated octavo volume of 160 pages and constitutes a valuable record of the position of scientific and technical instrument making in Great Britain at the present time. Although the number of firms exhibiting was slightly less than last year, the space required for their exhibits was greater, and an additional hall on the lower ground floor of the College was utilised. The circulation of the catalogue a few days before the exhibition opened was of great assistance to those at a distance who wished to purchase apparatus, as it allowed them to see which firms make the apparatus and which stands it was necessary to visit in order to compare their productions. Apparatus not previously exhibited was indicated as usual in the catalogue by an asterisk, but there appears at present to be no sign indicating when new apparatus involves the application of a principle not previously used in that type of apparatus, although there was a number of exhibits to which such a sign might have been attached. The catalogue shows a tendency, which we think should be encouraged, for makers of apparatus to give sectional views and diagrams of electrical connexions instead of pictures of the outsides of the cases containing the apparatus. Present-day purchasers are more likely to be influenced by internal arrangements than by outside appearances. As the exhibits of the firms are given in alphabetical order in the catalogues and the numbering of the stands depends not on the name of the firm but on their position in the exhibition hall, it would save the time of a visitor at a stand, who wishes to turn up in the catalogue the firm exhibiting, if, when the description of the exhibit extends to several pages, the name of the firm appeared either at the head or in the margin of each page.

#### Exhibition of Electrical Measuring Instruments

AN article by R W Paul, published in the November issue of the *Journal of Scientific Instruments*, is of general interest, as it will help to keep green the memory of the Faraday Centenary Exhibition at the Albert Hall, London, in 1931. He gives excellent descriptions of many of the instruments shown, which illustrate the gradual development of accuracy and quickness in measurement. Ammeters were first made having needles of soft iron polarised by a powerful magnet and having a deflecting coil closely adjacent. In 1881, Ayrton and Perry designed such instruments, the scales being graduated in degrees, which were converted to amperes by the application of a constant. They were the first to use the term 'ammeter' instead of amperemeter. It is interesting to remember that Silvanus Thompson strongly discouraged the use of this word, and asked sarcastically why they did not also use the word 'vometer' for voltmeter. The Director of the Science Museum has arranged that much of the apparatus shown at the Exhibition will be displayed at the museum from February until May 1932.

### Control and Operation of Cable Telegraphy

THE success of short-wave radio telegraph 'links' during recent years is well known to have led to the merging of the most important of the cable and radio companies. In addition, the rapid strides made in radio telegraphy and in international telephony have produced the impression that submarine cable telegraphy is now of little value. In a paper read to the Institution of Electrical Engineers on Jan. 7 by H. Kingsbury and R. A. Goodman on cable telegraphy, it is stated that there are no signs of the supersession of transoceanic cable telegraphy by radio, due to economic or other reasons. The growth of cable communications between the countries of Europe and the rest of the world is both steady and satisfactory.

UNFORTUNATELY, it has always been the general policy of the European States to retain not only the control but also the actual operation of their telephone systems. Hence at the international meetings the majority of the delegates are merely representative of the interests of their governments. The immediate revenue accruing to the State rather than the development of a first-class foreign telegraph service is their main consideration. It is therefore difficult to introduce reforms, no matter how desirable they seem to the engineers of private companies. Cable companies could easily compete with the direct radio beam, provided that the companies had control of all stations and that land lines were available and properly maintained. Many minutes are added to the transmission time of a message by the mere handing over of traffic from a company to a government system. For example, a preferred rate message from San Francisco to Copenhagen handed in over the counter in the ordinary way occupies about fifteen minutes from the time it passes out of the sender's sight until it is in the hands of the addressee. On the other hand, a sender offering a short telegraph message by telephone in New York for London is reasonably certain of delivery in two minutes from the moment of completing dictation of the message in New York.

### Weather of 1931.

In a pamphlet entitled "Notes on the Weather of 1931", issued by the Meteorological Office (Air Ministry), the topsy-turvy character of last year's weather is clearly brought out. New 'records' for cold were set up in March and October, months that are only on the fringe of winter and sometimes provide summer warmth. On March 3 temperature fell to 1° F. at Braemar, and on March 10 to 5° F. at Rickmansworth. On the latter date temperature failed to rise above 30° during the day in many places in south-east England. The night frosts of the last week of October were in some parts of England the most severe ever recorded in that month. There was a pronounced tendency for the worst weather in the south-east of England to be reserved for week-ends and public holidays, and the August holidays provided some days that were much colder than those experienced at Christmas. The gale in the English Channel on Aug. 24 would have been noteworthy had

it occurred in mid-winter. No temperature within three degrees of the reading of 61° that was recorded at Aberdeen on Christmas Eve has ever been known there in December for at least sixty years. Mention should be made also of the very rare event of a tornado of the American type, on June 14, at Birmingham. Although not to be compared with the worst tornadoes experienced in America, this storm was violent enough for roofs to be stripped, and there was loss of life. The zone of destruction was, fortunately, a characteristically narrow one, varying from 200 yards to 800 yards. The year must be regarded meteorologically as one of the most eventful known since the Meteorological Office was inaugurated nearly eighty years ago.

### Prehistoric Stock of South Africa

At a meeting of the Royal Anthropological Institute (Section of Human Biology) on Jan. 8, Sir Arthur Keith exhibited a series of human skulls from the Matje River Rock Shelter, a newly discovered prehistoric site in the Zitzikamma District, on the coast of the Cape Province. The deposits in this rock-shelter, amounting to 21 feet in depth, were excavated by Prof. T. F. Dreyer, of Grey University College, Bloemfontein. The rock-shelter was first inhabited during the age of the 'Mossel Bay' culture, which is usually equated with one of the later palæolithic cultures of Europe, and this culture was richly represented during the formation of the deeper strata, amounting in depth to 14 feet. All the remains from the Mossel Bay strata manifest racial traits, which were first revealed by the discovery of the large-brained Boskop skull in 1913. Three of the skulls from the deepest Mossel Bay strata have peculiar features of the forehead, the frontal bones appear compressed from side to side, with a high median keel. This malformation, known as trigonocephaly, occurs occasionally in modern races. A tendency to trigonism is not uncommon among Bushmen and Hottentots, who may be regarded as descendants of the prehistoric stock of South Africa. Sir Arthur Keith added that South Africa was the home of the most remarkable of all prehistoric peoples known to us, a people or stock tending to produce individuals with brains of remarkable dimensions and with a tendency for infantile and juvenile characters to persist into adult life, a tendency which Prof. M. R. Drennan has termed 'pedomorphism'. Although remains of Bushmen have been found so far north as Lake Nyassa and Boskop remains in Northern Rhodesia, all the evidence at present points to South Africa as the evolutionary home of this prehistoric pedomorphic race.

### Prehistoric Gold Ornaments from Cornwall.

Two torques and six penannular armlets have been found by a farm labourer in a bank of earth on Amalveor Farm, in Towednack, near St. Ives, Cornwall. According to the *Times* for Jan. 2, one of the torques consists of three strips of twisted metal, the other, a single twisted coil, is of considerable length, its circle being 13 in. in diameter, and, being flexible,



it may have been worn twined several times round the neck or waist. Both have the ends bent back to form the familiar interlocking hook. Of the armlets four are simple metal rods, the remaining two are heavier, one being hexagonal and the other lozenge-shaped in section. The find is assigned to the middle or late bronze age, but it is to be noted that the simple armlets do not show the thickening of the wire at the ends characteristic of the developed type of armlet, which, in the British late bronze age, expanded into the cup-shaped terminals.

• THE number, character, and distribution of finds of prehistoric gold ornaments in Cornwall, of which that of a lunula, or crescent-shaped gold neck ornament, associated with a flat axe found at Harlyn Bay is the best known, would suggest that intercourse with Ireland, the undoubted source of these ornaments, began early, possibly at the very beginning of the bronze age, and was extensive. Not only did Cornwall provide tin, in which Ireland was poor, but it served as a stage in the voyage to Brittany and Iberia. Close intercourse between Ireland and Cornwall lasted well into Christian times, as is shown by the legends of the Cornish saints, though their many obviously mythical details point to a much earlier tradition. It is to be hoped that lack of funds will not stand in the way of the proposed excavation of the site on which this latest find was made. If it should prove a habitation site, as is conjectured, it should furnish much needed evidence corroborative of the dating of Cornish gold ornaments.

#### American Patent Law System.

UNDER the auspices of Science Service, Dr. E. J. Prindle gave, on Nov. 13, a radio talk on the American patent law system. He pointed out how backward agriculture and manufacturing were prior to the introduction of the patent system, which gave the inventor the exclusive right for seventeen years to make, use, and sell his invention. So great is the transformation made by the introduction of machinery, that in garnering wheat crops one man can, by its use, do the work formerly requiring ten men. Only one man is now required for every 250 acres. The making of agricultural machinery is a very large industry. The expense of developing a single invention often runs into hundreds of pounds, and sometimes, as in the case of the Curtis steam turbine, into hundreds of thousands of pounds. Without the possibility of recovering this sum and making a profit on the invention, neither individuals nor companies can afford to make and perfect inventions. Without the patent law, Edison could not have accomplished his great work which has benefited humanity. In connexion with electric lighting alone, Edison took out 375 patents. As a patent for an invention gives a monopoly, some think that it is therefore harmful, as many monopolies undoubtedly are. But a patent only gives an inventor a monopoly of that which he creates, it takes nothing from the public, and at the end of seventeen years the public receives the invention free. In normal times, the patent system has greatly increased the field of employment.

#### Hawks as Decoys.

MARTIAL's epigram on the hawk (Book 14, 216) has been taken as an indication that falconry was practised by the classical ancients, but as the hawk here deceives (*decipit*) the birds, it would seem rather as if it were used, like an owl, as a decoy to entrap birds coming to mob it, and in the *Field* for Dec. 26, 1931, Col. Nawab Malik Sir Umar Hayat Khan, in writing on falconry, indicates a similar practice in modern India, for he says that if a sparrow-hawk be kept under a net or in a cage and nooses made around, and the receptacle put where 'seven sisters' are common, these birds (the common Indian babbler *Turdoides tericolor*) can be caught by the dozen. Being weak flyers, they are particularly likely to be attacked by hawks, but being also sociable and strong in beak and claws, they often succeed in rescuing the bird attacked, so that the hawk is an enemy with which they contend on more or less equal terms. The use of the captive hawk as a decoy, however, is no more falconry than is the employment of wild hawks in fowling by bribing them to 'wait on' and make birds lie, a practice also followed in classical times and in India and Argentina in our day, when the former country is still the stronghold of the perfected art.

#### Statistics of Cancer in East London.

THE Ministry of Health has issued a report by Dr. Janet Forber (*née* Lane-Claypon) dealing with incurable cases of cancer in east London (*Reps. on Pub. Health and Med. Subjects*, No. 66, H.M. Stationery Office, 1s. net). There appears to be no shortage of medical and nursing care and hospital accommodation for these patients. The sample of 1983 cases investigated brings out (as other investigations have done) a contrast in sex incidence of the disease, namely, the great preponderance of cancer of the lip, tongue, mouth, pharynx, and larynx in the male, and cancer of the reproductive organs in the female. The mean age at death is low for fatal cancer of the uterus, ovary, and, in both sexes, the lung and pleura, and high for fatal cancer of the skin and prostate. The mean duration of in-patient care for those who seek hospital treatment is only 2.28 months, being less than one month for 46 per cent, suggesting that the terminal and troublesome stage of fatal cancer is, happily, of short duration.

#### Researches in Chemical Engineering

WE have received the *Proceedings of the Chemical Engineering Group, Society of Chemical Industry*, vols. 11 and 12, 1929 and 1930 (in one volume). This contains a number of valuable papers, dealing with such subjects as surface energy, flotation, water treatment, alloy steels, gas and electric heating furnaces, and welding. The standard of the papers is high, and they are usually followed by interesting discussions. The *Transactions of the Institution of Chemical Engineers*, vol. 8, 1930, has also been received, and contains important papers on various subjects related to chemical engineering, such as cellulose products, crystallisation, high pressure reactions, tannery waste, wood pulp, pulverised fuel, and the recovery of metals from waste materials. Both these volumes are very

well printed and illustrated, and form valuable contributions to the literature of applied chemistry and engineering

#### U.S. Bureau of Standards

*Miscellaneous Publication* No 131 of the Bureau of Standards, Washington, constitutes the Annual Report of the Bureau for the year ending June 1931. Notwithstanding the decrease in industrial activity in the United States, the demands on the Bureau for its services were greater than in the previous year, and the working costs were 2,600,000 dollars, an increase of 5 per cent on last year. The staff number nearly 12,000, and the salaries 710,000 dollars. A new hydraulic laboratory, capable of dealing with 300 cubic feet per second, and two new radio stations have been built, and a new administrative building and a high voltage laboratory are in contemplation.

#### Announcements

THE gold medal of the Royal Astronomical Society has been awarded to Dr Robert Grant Aitken, director of the Lick Observatory, Mt Hamilton, California, for his work on double stars.

SIR ROY LISTER ROBINSON, technical commissioner in the Forestry Commission, has been appointed chairman of the Commission, in succession to Sir John Stirling-Maxwell, who is retiring on March 25 next.

THE following appointments in the Colonial agricultural services have recently been made by the Secretary of State for the Colonies. Mr A. J. Findlay, deputy director of agriculture, Nigeria, to be director of agriculture, Zanzibar, Mr T. Y. Watson, to be agricultural officer, Kenya.

THE Melchett Medal for the year 1931 of the Institute of Fuel has been awarded to Prof William A. Bone, professor of chemical technology in the Imperial College of Science and Technology, London. This medal was founded in 1930 by the late Lord Melchett, and is given for original research or professional, administrative, or constructive work involving the scientific preparation or use of fuel, which has recently been made available to the community. The first award was to Dr Kurt Rummell, of Dusseldorf.

A JOINT committee of the British Empire Cancer Campaign and the Mount Vernon Hospital has appointed Dr A. E. Barclay, lecturer in medical radiology and electrology in the University of Cambridge, to the Radiological Research Fellowship founded by Sir William Morris at the Mount Vernon Hospital.

It is announced in *Science* that the Henry Draper Medal of the U.S. National Academy of Sciences has been awarded to Dr Annie J. Cannon, of Harvard College Observatory, for her work on the classification of stellar spectra. This medal is given "for notable investigations in astronomical physics." Dr Cannon is the first woman to receive a medal from the National Academy of Sciences. The Agassiz Medal of the

Academy, given for contributions to oceanography, has been awarded to Prof H. B. Bigelow, director of the Oceanographic Institution at Woods Hole.

THE course of open lectures in anthropology at the Royal Anthropological Institute for the second half of the session 1931-32 is announced. The course has been arranged in co-operation with the School of Oriental Studies, and will deal with African life and customs. The list of subjects and lectures is as follows: Jan 20, F. H. Melland, on natural resources of Africa; Jan 27, Prof C. G. Seligman, on races of Africa; Feb 3, C. W. Hobley, on the development of native education in Kenya; Feb 16, Capt R. S. Rattray, on Hausa poetry; March 2, Rev. E. W. Smith, on the place of folk-tales in African life; March 9, H. J. Braunscholtz, on the craft of the African potter; March 16, J. H. Driberg, on African systems of education. The lectures begin at 5 P.M. on each day, and admission is free and without ticket.

A LIST (C 1931) of some 1586 works relating to science, including publications of the Geological Survey of Great Britain, Smithsonian Miscellaneous Collections, and publishers' remainders, has been issued by Messrs Wheldon and Wesley, Ltd, 2 Arthur Street, W.C.2.

THE latest catalogue of Messrs Bernard Quaritch, Ltd, 11 Grafton Street, W.1 (No 452), should be of much interest and service to librarians and others, giving as it does particulars of some 1300 works relating to science, mainly in the form of periodical literature, transactions of learned societies, and records of voyages of exploration. Many of the entries have valuable bibliographic notes appended.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: A demonstrator in pathology and bacteriology at the Welsh National School of Medicine—The Acting Secretary, University Registry, Cathays Park, Cardiff (Jan 21). A senior chemistry master at Emanuel School, Wandsworth Common—The Headmaster, Emanuel School, Wandsworth Common, S.W.11 (Jan 23). A temporary senior technical assistant in an Admiralty establishment near London, with experience in the design of light precision machinery and small accurate gearing—The Secretary of the Admiralty, C.E. Branch, Admiralty, Whitehall, S.W.1 (Jan 29). An expert under the Egyptian Government, for the study of sugar-cane pests and methods of control and to organise the application of control measures, also for the study and carrying out of research work on the varieties of sugar-cane most adapted to local conditions, methods of cultivation, and other factors tending to improve sugar culture—The Minister of Agriculture, Cairo (Feb 15). A head of the mathematics department of the Woolwich Polytechnic—The Principal, Woolwich Polytechnic, Woolwich, S.E.18 (Feb 17). A director of the Indian Institute of Science, Bangalore—The Selection Committee, Directorship Indian Institute of Science, Bangalore, c/o The Universities Bureau, 88A Gower Street, W.C.1, (before end of April).

## Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

## Velocities of the Spiral Nebulae.

THE extraordinary velocities of recession which are derived from the shift toward the red of the spectral lines of remote galaxies have led to much scepticism of the interpretation of this shift as a Doppler effect, and this scepticism is enhanced when it is learned that the velocities are proportional to the distances of the galaxies. No other interpretation in terms of ether waves seems to be satisfactory, but there is an interpretation in terms of light quanta, or photons, that is much less disturbing.

The energy of a photon is  $\epsilon = h\nu$ , where  $h$  is Planck's constant and  $\nu$  is the frequency. If one supposes that there is a leakage of energy from the photon in its long journey of millions of years, due perhaps to an inherent instability in the photon, or, possibly, to collisions with other photons, it is evident that the frequency declines with the energy, and the lines of the spectrum are shifted toward the red.

For the Doppler effect  $\nu = \nu_0(1 - v/c)$ , where  $v$  is the velocity of recession and  $c$  is the velocity of light. Hubble and Humason<sup>1</sup> find, from observation of these distant objects, the relation

$$v \text{ (in km per sec)} = \frac{x \text{ (in parsecs)}}{1790},$$

so that

$$\frac{v}{c} = \frac{x \text{ (in parsecs)}}{3 \times 1790 \times 10^5} = \beta x$$

If, instead of this linear relationship between velocity and distance, one takes  $v/c = (1 - e^{-\beta x})$ —and the two hypotheses are indistinguishable on the basis of the observational data—then the relation between frequency and distance due to Doppler effect is  $\nu = \nu_0 e^{-\beta x}$ .

On the other hand, if one supposes that the percentage loss of energy from the photon per unit distance is constant, one has

$$\frac{1}{\epsilon} \frac{d\epsilon}{dx} = -a,$$

where  $a$  is some constant. Consequently,  $\epsilon = \epsilon_0 e^{-ax}$ , or, on dividing through by Planck's constant,  $\nu = \nu_0 e^{-ax}$ . That is, the assumed tendency of the energy of the photon to evaporate in its long journey through space leads to a law of frequency which is indistinguishable in form from the law of Doppler effect as given by Hubble and Humason.

On the basis of energy leakage and the observed shift of the spectral lines, a light quantum loses one per cent of its energy in 5,400,000 parsecs, or 17,600,000 years. It requires 372,000,000 parsecs, or 1,210,000,000 years, for one-half of its energy to escape. Such an interpretation of the extraordinary shifts that are observed will be more acceptable to many than an interpretation which makes our galaxy a centre from which all others are fleeing with speeds that are proportional to the distances.

If the energy which has evaporated from the photon continues to exist as radiant energy, there should exist an abundance of radiation of very low frequency, and there is at present no evidence of such radiation. Another possibility, however, is that it disappears into the fine structure of space and reappears eventu-

ally in the structure of the atom. The process by which this is accomplished, however, lies far outside the range of our experience, and until we know much more about the atom than we do at present, it is useless to speculate about it.

W D MACMILLAN

University of Chicago,  
Dec 9, 1931

<sup>1</sup> *Astrophys J*, 74, 76, July 1931

## Oxygen and Everest.

MR ODELL's interesting letter<sup>1</sup> re-emphasises conclusions drawn from the Everest expeditions as to the value of oxygen breathing apparatus and upholds the importance of acclimatisation. He states that acclimatisation at 27,000-28,000 feet should be aimed at, and then oxygen used for the last 1000 feet of ascent. As it takes weeks for the party to reach 27,000 feet, experiments in pressure chambers conducted on normal men for a few hours' duration are of no significance. We know, however, that natives do not go and live in the summer months above 18,000 feet, and the question arises whether it is the altitude or the extent of the pastures which sets this limit.

It was on account of this that Dr Argyll Campbell carried out many experiments with animals while I was in charge of the Department of Applied Physiology at the National Institute of Medical Research. He used monkeys, cats, rabbits, guinea-pigs, rats, and mice, enclosing these animals almost continuously in chambers for many weeks, either the oxygen partial pressure, or the barometric pressure being lowered gradually to resemble the conditions on the mountains. In the latter case, use was made of a chamber at the works of Messrs Siebe Gorman. His results have been published and clearly show that at 20,000-29,000 feet the oxygen tension in the tissues is not kept at normal, but is markedly subnormal, further, there result pathological changes, particularly in the heart, liver, and brain. Also, he found that breathing oxygen at normal pressure for one hour daily did not help these animals materially.

Thus in the so-called acclimatisation at these great altitudes the members of the expeditions will be deteriorating continuously, that they did so in the past expeditions is proved not only by the fact that climbing became most difficult, but also that they all lost weight and appetite. The climbers who persevered at 28,000 feet or above all came to grief.

Another expedition of the same type is likely to end similarly unless other precautions are taken. Dr Campbell found that out of more than a hundred healthy animals only about ten could tolerate the low oxygen partial pressure which pertains at 29,000 feet for any length of time. A few animals survived for eight days—a record—under this pressure, and recovered their health again when put under normal conditions.

It is obviously very difficult to pick men able to tolerate such a low oxygen pressure for such a prolonged period as is necessary on the mountain. The climbing party should be increased in numbers, and thus the chance of one of them carrying on after 28,000 feet, with or without the use of oxygen breathing apparatus, will be increased. All the evidence from the expeditions and from these experiments on animals leads to one conclusion, namely, above 28,000 feet deterioration is rapid and excessive, and no acclimatisation prevents this. If the climbers were continuously supplied with oxygen at normal pressure they could, of course, proceed straight up to the

summit. Some day, perhaps, a liquid oxygen apparatus will be established at the 18,000 feet level and Everest thereby conquered in safety.

LEONARD HILL

Nicholls Wood,  
Chalfont St Peter

<sup>1</sup> NATURE, 128, 1037, Dec 19, 1931

WITH most of what Mr N. E. Odell says,<sup>1</sup> in commenting upon my paper "Oxygen and Everest", I am entirely in agreement. There are one or two points, however, on which I would like to reply.

Though Mr Odell does not actually suggest it, it might possibly appear that I had cast doubt on the possibility of acclimatisation to 29,000 feet. There is, of course, no reason to doubt the possibility, on lines either theoretical or practical. There is, however, an element of doubt as to whether so high a degree of acclimatisation can be obtained in the time available, owing certainly to the slowness of the process and possibly to the onset of altitude deterioration.

I agree that "there is nothing to warrant Dr. Greene's supposition that their [Mallory and Irvine's] failure to return was due to a breakdown in the oxygen apparatus". I have never supposed such a thing. It has never even occurred to me. I did, however, suggest as a possibility that their *lateness* might be due to this cause. This is a very different matter, and it remains a possibility, but not a supposition.

Many climbers certainly believe that Everest should be climbed without "such artificial aids as may reduce a sport to a mere laboratory experiment". Others believe that such aids may raise a mere sport to the dignity of a laboratory experiment. But I do not follow the sentence with which Mr Odell follows up this appeal to all that is best in British sport. No one wants to repeat the steel chamber experiment he has mentioned. Some even wonder why it was ever done. But we do want to know by direct experiment whether oxygen is of use to an acclimatised man and we do want to know whether a man can acclimatise fast enough to climb Everest in the time available. Where, as Mr Odell says, can these things be better studied than on Everest?

I made no mention of my ammonium chloride experiments because they are still in their infancy and any conclusions based upon them would be premature and unsound.

Through my carelessness, two misprints appeared in my article. In paragraph 4 'exponents' should read 'opponents', and in the last paragraph 'mid' should read 'wind'.

RAYMOND GREENE

10 Holywell, Oxford  
Dec 23, 1931

<sup>1</sup> NATURE, 128, 1037, Dec 19, 1931

#### L-Discontinuities in X-Ray Absorption.

By definition, the absorption coefficient is the factor of proportionality of absorption in an infinitely thin layer. The atomic absorption coefficient, then, is the factor of proportionality for a very small number of atoms. This factor, therefore, can be said to be a measure of the probability of absorption for each photon passing the atom.

It is also obvious from Kossel's atomic model that if an electron has been removed from a certain level by an absorption process, this must be accompanied by an emission process corresponding to an electronic transition into the vacant position. Therefore the absorption processes of the highest excited level must be as frequent as the emission processes from this level. The coefficient of absorption therefore must be

a measure not only of the probability of absorption but also of the probability of emission.

We shall now consider the special case when the frequency of the absorbed radiation has reached the  $L_m$ - and  $L_n$ -absorption limits but not  $L_i$ . The excited levels are then  $L_{22}$  and  $L_{21}$  and, of course, lower levels. Now the unusually well-established rule of Burger and Dorgelo can be used. It is possible to arrange the lines, originating from those levels, in doublets or triplets in such a way that the ratio of intensity of the components is 1.2, according to the rule mentioned. For example,  $\beta_1/(\alpha_1 + \alpha_2) = 1.2$ ,  $\gamma_1/(\beta_2 + \beta_{15}) = 1.2$ ,  $\eta/l = 1.2$ . Generally 1.2 is the ratio of the numbers of quanta emitted from the two levels. Therefore the numbers of absorption processes must have the same proportions. We then conclude that when the frequency of the absorbed radiation exceeds the  $L_n$ -absorption limit, the probability of absorption will increase with 50 per cent of the probability of absorption in the  $L_{22}$ -level. If we take in account also the  $M$ -absorption, we can give the expression

$dL_n = \frac{1.5a + m}{a + m}$ , where  $m$  is proportional to the absorption in the  $M + N + \dots$  levels and  $a$  to the  $L_{22}$ -absorption. For elements with low atomic number,  $m$  will be negligible and therefore  $dL_n = 1.50$ . The only experimentally determined values available are Ag(47)  $dL_n = 1.47$ , Pt(78)  $dL_n = 1.37$ , Au(79)  $dL_n = 1.38$ , Hg(80)  $dL_n = 1.39$ . They also confirm that  $dL_n > 1.50$  with decreasing atomic number.

E. Jonsson calculates the absorption using formulæ such as  $dL_n = \frac{E_{L_n}}{E_{L_{22}}}$ , where  $E$  represents the  $\nu/R$  value

of the designated absorption limit. In the case of silver, for example, we get in this way  $dL_n = 1.05$ . Although the formula holds for the  $K$  and the total  $L$  discontinuity, in the case of  $dL_n$  it has no justification.

It is not possible to calculate in the same way as  $dL_n$  the other  $L$ -discontinuities. The lines of  $L_n$ , for example, cannot be arranged in groups with lines from the other  $L$ -levels, the components having a constant ratio of intensity. One would suppose that the experimentally found sum of the intensities of all the lines originating from a certain level would give a value of the probability of absorption in this level. The agreement is not good, however. In the case of silver we calculate  $dL_n = 1.10$ , but experimentally it is found to be  $dL_n = 1.25$ .

On the basis of the new quantum mechanics, Wentzel calculated the relative intensities of a number of lines in the  $L$ -series. In several cases his values are considerably higher than the observed data. Wentzel suggests that the failure may depend on 'non-radiating transitions' or inner absorption, that is, the photons emitted are partially reabsorbed in the lower levels before leaving the atoms. But such emitted quanta must also be included in the calculated rate of emission from different levels. If Wentzel's explanation of the difference between the calculated and observed values is quantitatively correct, we can best make the correction for the inner absorption by using his calculated values. This gives  $dL_n = \frac{1.79a + m}{1.46a + m}$ ,

giving 1.23 as the upper limit to which the  $dL$ -discontinuity tends with decreasing atomic number. In fact the observed values are Ag(47)  $dL_n = 1.25$ , Pt(78)  $dL_n = 1.25$ , Au(79)  $dL_n = 1.25$ , Hg(80)  $dL_n = 1.18$ . Perhaps this can be said to provide the experimental agreement to Wentzel's calculations not given by the directly observed intensities of the emitted lines.

E. OLSSON

Laboratory of Physics,  
University of Stockholm, Dec 6

## Atomic Moments of some Metals

M. CH. SADRON a fait, dans mon laboratoire, une étude de l'aimantation à saturation des solutions solides des métaux dans le nickel ou dans le cobalt, dans les champs intenses et aux basses températures. Il a trouvé ainsi que de nombreux métaux possèdent des moments ferromagnétiques et a déterminé leur grandeur.

Si l'on ajoute au nickel un métal M, le moment atomique moyen est représenté par la droite AC (Fig 1), d'après la loi des mélanges. Le commencement AB de cette droite est observable et son prolongement donne en C le moment du métal M.

On trouve ainsi pour le palladium et pour le platine le moment de 3 magnétons (1 magnéton = 1126.5) qui est aussi celui du nickel. Donc les éléments situés, comme le nickel, le palladium et le platine, dans une même colonne du système périodique ont le même moment.

Les solutions du manganèse dans le nickel ont donné +15 magnétons pour manganèse, par contre celles du manganèse dans le cobalt ont donné -15 magnétons. Dans le nickel, le moment 15 du manganèse se place

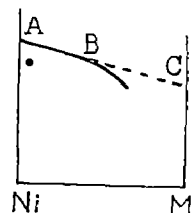


FIG 1

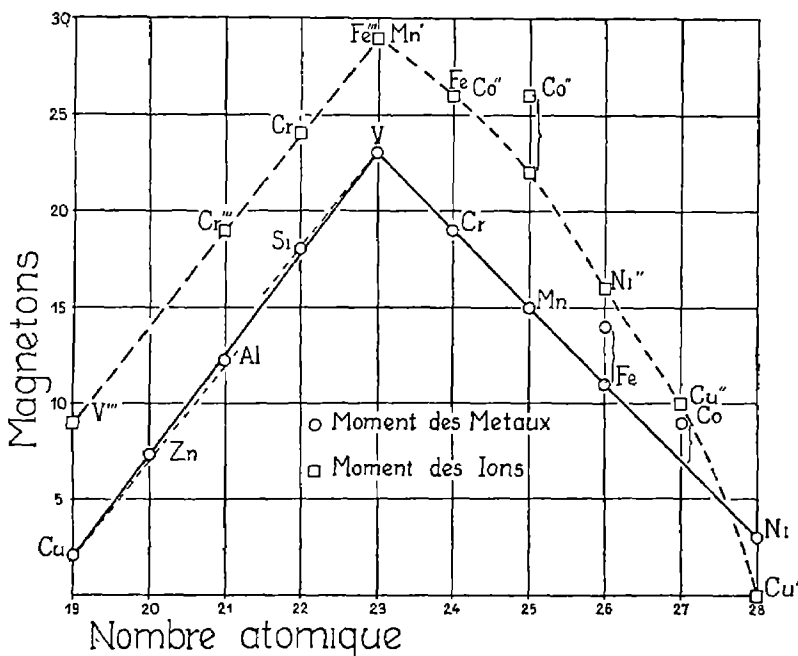


FIG 2

parallèlement, dans le cobalt antiparallèlement au moment du solvant. L'orientation antiparallèle est la plus fréquente, c'est celle du cuivre, du chrome dans le nickel. Mais aussi bien que l'orientation parallèle, elle permet la détermination du moment. On trouve ainsi pour le chrome, le molybdène, le tungstène, qui sont situés dans la même colonne, le même moment de 19 magnétons.

La détermination des moments de la ligne horizontale du fer a été faite soit sur les éléments eux-mêmes, soit en les remplaçant par d'autres éléments de leur colonne. Ainsi le scandium a été remplacé par l'aluminium, etc.

Les résultats sont représentés en trait plein dans la Fig 2 (La ligne interrompue est la courbe de Cabrera du moment des ions).

Les moments ferromagnétiques se placent sur deux droites se rencontrant au vanadium, qui a le moment le plus élevé, égal à 23 magnétons. La pente de la partie ascendante est voisine de 5 magnétons, ou un magnéton de Bohr, celle de la partie descendante est exactement égale à 4 magnétons.

PIERRE WEISS

Institut de Physique,  
Université de Strasbourg,  
4 décembre

## Diamagnetism of Liquid Mixtures.

CRITICISMS of our magnetic susceptibility measurements of mixtures of acetone and chloroform<sup>1</sup> have been made by Ranganadham,<sup>2</sup> van Aubel,<sup>3</sup> Buchner,<sup>4</sup> and Ramachandra Rao and Sivaramakrishnan.<sup>5</sup> We have therefore repeated the susceptibility measurements of this series of liquids by the Gouy method, using a magnet with a field strength of about 3300 gauss. The apparatus not being available in this laboratory, Dr S. Sugden, to whom we wish to express our thanks, kindly permitted us to make use of his apparatus at Birkbeck College. With this particular apparatus values of the susceptibility can be obtained which are accurate to within  $\pm 0.02 \times 10^{-6}$ .

The results of the new set of measurements show that we are decidedly in error, whilst our critics are right in respect of the sign of the susceptibility of mixtures of acetone and chloroform and of the compound formed by these two substances. Our critics, however, are not in agreement as to the amount by which the susceptibility of mixtures of acetone and chloroform diverges from the simple mixture rule. Dr Buchner finds that the maximum deviation is 2 per cent. Messrs Ramachandra Rao and Sivaramakrishnan find no deviation from the mixture rule, and Mr Ranganadham finds a maximum deviation of 3 per cent.

Dr Buchner points out that we give the density of dimethyltrichloromethyl carbinol as 0.66, this figure is due to an error of transcription and should have read 1.66. Freshly sublimed material has been prepared and this specimen, which is white, has the value  $d_4^{25} = 1.49$ . The following mass susceptibilities have been obtained: acetone -  $0.60 \times 10^{-6}$ , chloroform -  $0.51 \times 10^{-6}$ , and dimethyltrichloromethyl carbinol -  $0.59 \times 10^{-6}$ . The maximum deviation of the susceptibilities of the mixtures from the straight line is not more than 5 per cent, and it lies at the equimolecular mixture.

The values given above agree reasonably well with those given by Dr Buchner, and our new value for acetone is now in agreement with the figure given by Pascal.

So far as we are able to judge, the error in our measurements has arisen through a mechanical defect in the arrangement for moving the magnet from one fixed position to the other, thus leading to an inaccurate deviation being recorded. From our laboratory notes it is fairly clear when the defect occurred, and therefore we propose to remeasure, and correct where necessary, the whole of our magnetic measurements, using a new apparatus which we are installing.

at the moment and which will be capable of furnishing a very much stronger field

Since the above was written, Dr J Farquharson has published a letter<sup>8</sup> giving results which are in complete agreement with those above

JAMES F SPENCER  
C G TREW

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Bedford College,  
University of London

<sup>1</sup> Trew and Spencer, *Proc Roy Soc*, **131**, p 209, 1931

<sup>2</sup> Ranganadham, *NATURE*, **127**, 975, June 27, 1931

<sup>3</sup> van Aubel, *NATURE*, **128**, 455, Sept 12, 1931

<sup>4</sup> Buchner, *NATURE*, **128**, 301, Aug 22, 1931

<sup>5</sup> Ramachandra Rao and Sivaramakrishnan, *NATURE*, **128**, 872, Nov 12, 1931

<sup>6</sup> Farquharson, *NATURE*, **129**, 25, Jan 2, 1932

### Oysters in Law.

THE European oyster, or flat oyster, *Ostrea edulis*, Linn, occurs in many places off the Atlantic and Mediterranean coasts of Europe. In all these localities this oyster in the warmer periods of the year reproduces its kind by extruding eggs from the body, but it retains and incubates these eggs within its shell-spaces until the resulting larvæ have developed organs which permit an independent free-swimming life. The incubation of eggs to the larval stage is thus a common character of English, Irish, Scotch, Norwegian, Danish, German, Dutch, French, and Italian flat oysters. At present all these flat larviparous oysters are regarded as belonging to one species, namely, *Ostrea edulis*, Linn, except for certain oysters occurring in the Adriatic Sea,<sup>1</sup> albeit a large number of varieties have been given special names<sup>2</sup>

It has long been recognised in England that the consumption of English native oysters during the warmer months, that is, the breeding period, is undesirable for many reasons, one important one being the danger to the consumer of infection from harmful bacteria and other noxious materials which may be passed on by oysters weakened by the process of breeding, and otherwise deleteriously affected by transport in the warm conditions usually prevailing in the breeding period.

The sale of English native oysters (*O. edulis*) for consumption during certain months of the year (usually the breeding months) has been prohibited by law since 1877,<sup>3</sup> but foreign oysters, including American (*O. virginiana*) and Portuguese (*O. angulata*) as well as foreign *O. edulis*, were exempted by that law, and remain exempted. The American and Portuguese oysters do not incubate their young, they do not spawn much in Great Britain, and may be expected normally to maintain themselves in good condition for consumption during the summer: there are therefore fewer objections to the sale of these forms for consumption in summer than apply to *O. edulis*. On the other hand, foreign *O. edulis* are in essentially the same category as English *O. edulis* with regard to their liability to weakness in the warmer months of the year, for there can now be little doubt that *O. edulis* may breed in the sea in varying percentages in any locality at any time the sea-water is maintained steadily above the level of about 58°-59° F.<sup>4 5 6</sup> Thus every objection to the sale of native, or English-grown, *O. edulis* during the breeding period on the ground of safeguarding public health is equally applicable to foreign *O. edulis*, whether these be reared in English waters or not.

Efforts have been made in the past to bring foreign flat oysters (*O. edulis*) under the same regulations as English,<sup>7</sup> but the objects have been confused by (a) the lack of recognition that foreign oysters may be of three kinds, namely, (1) American (*O. virginiana*), (2)

Portuguese (*O. angulata*), which are both non-larviparous forms, and (3) European flat larviparous oysters (*O. edulis*), which are conspecific with English natives, and (b) the desire to protect and husband the English oyster beds during the breeding season. At the present day, probably little opposition would be offered to a law prohibiting the sale of foreign *O. edulis* in the British Isles during the same period and under the same conditions as the sale of English *O. edulis* is prohibited. The present time is also highly propitious for the passage of such a law, as the economic disturbance would be slight—owing to the relative scarcity of *O. edulis*—and the Parliamentary machinery may find little difficulty in dealing with the matter.

English oyster beds, it may be observed, require nursing during the non-breeding as well as during the breeding period, according to local requirements, moreover, the variation in the length of the breeding period in different localities also renders it desirable that a measure of power should be delegated to local authorities—as in fact exists at present—to modify, within limits, any general prohibitory regulation.

The biological facts given above are presented independently as a biological duty now somewhat overdue, but there would seem to be little doubt that if the oyster merchants and others concerned could meet to discuss this problem, agreement might soon be reached resulting in the removal of an anomaly, which is possibly not very serious, but is nevertheless a haunting menace not only to public health but also to the oyster trade itself.

J H ORTON

Zoological Laboratory,  
University, Liverpool,  
Dec 24, 1931

<sup>1</sup> Faber, "Fisheries of the Adriatic", 1883

<sup>2</sup> Bell, *Essex Naturalist*, **19**, 1921

<sup>3</sup> Fisheries Act (Oysters, Crabs, and Lobsters), 1877 (40 and 41 Vict c 42)

<sup>4</sup> Orton, *J Mar Biol Assoc*, **15**, 417, 1928

<sup>5</sup> Sparek, *Reposit Dan Biol Stat*, **35**, 1929

<sup>6</sup> Fisheries Expt Station, Conway, Annual Reports

<sup>7</sup> Rep Select Comm on Sea Fisheries, 383, 1893

### Geological Sequence of Coombe Deposits at Greenhithe, Kent

A STUDY of the Geological Survey Map (Sheet IX, N E Kent, scale 6 in to 1 m) reveals four lateral valleys, now filled with Coombe Deposits of Pleistocene age, which formerly drained into the Thames. The Geological Survey has described one of these valleys as follows:

"Besides the bedded gravels and brickearths which have been laid down at various periods by the rivers, there are deposits which, although occurring in the valleys, show little sign of arrangement by running water. In many of the smaller valleys, more particularly in Kent, we find the bottom filled with an accumulation of mixed material to which the name 'Coombe Deposits' may be given. These masses have been formed by the descent of material from the sides of the valleys, and take their character from that of the deposits available at any spot: thus, in the valley starting near Bean and opening into the Thames at Greenhithe the Coombe Deposits include gravel from the High Terrace deposits, a sandy loam formed of Tertiary material and best described as brickearth—it has, indeed, been used on a small scale for brick-making—and chalk rubble. The last resembles the deposit known as 'Coombe Rock', the origin of which has been discussed by Clement Reid, and the whole assemblage has probably been formed in the same way, the period of formation appears to be that of the down-cutting between the Middle and the Low



Terraces and of the cold period at the base of the latter"<sup>1</sup>

The deposits composing the infilling of the lower part of this valley are shown by the Survey to be "Brickearth 2 to 4 feet", "Gravel with big flints 0 to 6 feet", and "Chalk Rubble 6 feet", whilst in the tramway-cutting immediately west of Cobham Terrace a section is recorded as "Brickearth 2 feet", "Gravel 4 feet", and "Chalk Rubble 8 feet"

Here, as in the lateral valley to the east,<sup>2</sup> I have found the stoneless brickearth, which rests upon the melt-water gravels of the Coombe Rock and underlies the stony loam, to contain artefacts of Upper Palaeolithic types together with calcined flints. In places the Bean-Greenhithe brickearth is calcareous and tuffaceous, when, in addition to the implements exhibiting a white porcellaneous patination, the shells of various land molluscs of temperate species have been preserved in the deposit

The researches I have undertaken within the area included on Sheet IX, N.E. Kent, 6 in to 1 m, definitely establish a break in the deposition of the Coombe Deposits, a break which occurred after the melt-waters of the Coombe Rock glaciation had subsided, but prior to the deposition of the stoneless brickearth<sup>3</sup>

In the geological sequence the Survey places the Coombe Deposits between the formation of the Middle and Low Terraces this correlation is supported on archaeological evidence in the vicinity of Belmont Castle, Grays, Essex, where the Coombe Deposits are overlain by the Upper Flood Plain gravels<sup>4</sup>

The break in the deposition of the Coombe Deposits referred to above must necessarily represent the interglacial phase coincident with the Upper Palaeolithic (Upper Mousterian, Aulignacian, and Solutrian) period

J P T BURCHELL

30 Southwick Street,  
Hyde Park, W 2, Dec 12

<sup>1</sup> *Mem. Geol. Survey* (London District), 1922, pp 59-60

<sup>2</sup> NATURE, Sept 26, 1931

<sup>3</sup> NATURE, Nov 28, 1931

<sup>4</sup> NATURE, Jan 2, 1932

### Structure and Development of Temperature Inversions in the Atmosphere

THE present view of the development of temperature inversions in the atmosphere with a sudden decrease of humidity with increase of height as due to a general slow descent of air from higher levels,<sup>1</sup> regards the appearance of the temperature discontinuity as a condition precedent to the development of humidity discontinuity in the form of a haze or cloud layer below it. Kopp,<sup>2</sup> however, from the experience of his aeroplane flights, pointed out that after the passage of a cyclone, humidity discontinuity in the form of haze or cloud layer precedes the temperature discontinuity, the latter being probably brought into existence as a result of radiation from the haze or cloud layers. An examination of Lindeberg and Berlin kite and aeroplane ascents confirms the view that dry inversions in the free atmosphere can and do owe their origin to humidity discontinuities in the form of haze layers or cloud sheets

In a forthcoming publication, we have discussed the rôle of subsidence and radiation in the production of inversions both qualitatively and quantitatively. It has been shown that subsidence combined with turbulence up to a definite limit<sup>3</sup> cannot adequately explain the development and maintenance of dry horizontal inversions in anticyclonic weather, but that radiation from the top of cloud or haze layers combined with turbulence up to a definite limit offers a

more satisfactory explanation. Taking, for example, a cloud sheet at a temperature of 273° abs with air of 40 per cent humidity above it, and assuming the eddy conductivity within the cloud to be 10<sup>3</sup> C G S units, the cooling of the top of the cloud by radiation in 10 hours comes out to be of the order of 25° C. If the eddy conductivity is increased to 10<sup>4</sup> C G S units, the cooling becomes 8° C, with another cloud sheet above with the temperature of its base at 263° abs the cooling comes out to be 5° C and 2° C respectively. The spreading upward of this cooling by radiative diffusion and eddy conduction has been calculated in the way suggested by Brunt.<sup>4</sup> The temperature-height curves thus obtained above the cloud agree with observed results.

On the basis of Mendenhall and Mason's experiments<sup>5</sup> on the "stratified subsidence of suspended particles", a mechanism has also been suggested for the production of a number of haze layers in the atmosphere met with in one single aeroplane ascent after the passage of a cyclone. These haze layers give rise to humidity discontinuities, and in some cases to cloud sheets later, which in turn are responsible for the development of dry inversions.

SOBHAG MAL  
S BASU  
B N DESAI

Meteorological Office,  
Ganeshkind Road, Poona 5 (India),  
Nov 21

<sup>1</sup> Hann Suring, "Lehrbuch der Meteorologie", 1926, p 164

<sup>2</sup> Beir, "Zur Phy. der freien Atmos", Hergesell-Festschrift, p 266, 1929

<sup>3</sup> Douglas, *Q J R. Met. Soc.*, 55, p 137, paras 4, 7, 1929

<sup>4</sup> *Proc. Roy. Soc. A*, 130, 1930

<sup>5</sup> *Proc. Nat. Acad. Sci., U.S.A.*, 9, pp 199-207, 1923. See also Morrison, *Proc. Roy. Soc. A*, 108, pp 280-284, 1925

### Thermal Chlorination of Methane.

ON correlating the data in two recent papers<sup>1, 2</sup> on the thermal chlorination of methane and methyl chloride, it appears that there is a possibility that the four hydrogen atoms of methane are not simultaneously equally available for chlorination, but that after the substitution of one of them the other three are

Pease and Waltz<sup>2</sup> have shown that the chlorination of methyl chloride proceeds more rapidly than the chlorination of methane, that is, the relative reaction velocities of methane and methyl chloride chlorination are not in the proportion of the numbers of hydrogen atoms in the molecules, and therefore not in agreement with this postulate in the derivation of Martin and Fuchs's<sup>3</sup> kinetic formulæ. The published results of Mason and Wheeler's experiments on the chlorination of methyl chloride (these are, of course, liable to error on account of the approximate fractionation methods used, though the error has been corrected for so far as possible) are in agreement with Martin and Fuchs's kinetic formulæ for a three-stage reaction, from which it would appear that the three remaining hydrogen atoms are equally available for chlorination, and that the relative reaction velocities for the successive stages are proportional to the numbers of residual hydrogen atoms.

Although Mason and Wheeler's results with methane are in fair agreement with the kinetic four-stage formulæ of Martin and Fuchs, it is apparent on close inspection that the amounts of methyl chloride and methylene chloride formed are respectively less and more than the amounts demanded by theory, although it would be expected from calculation that the methyl chloride would not be underestimated in the experiments with a large excess of methane. The results are in general agreement with those of Martin and

Fuchs (loc cit), who showed that the last three stages had velocities proportional to the numbers of residual hydrogen atoms

The point cannot definitely be decided until more complete experimental data are available. Further investigations are being carried out, these, it is hoped, will throw more light on the matter, or provide a different explanation.

The conclusions, however, are in harmony with those of Harkins and Bowers<sup>4</sup> on the carbon-halogen bond as related to Raman spectra, in that the frequency of the C-Br bond is constant in normal compounds with the exception of  $\text{CH}_3\text{Br}$ . The results of West and Farnsworth<sup>5</sup> on normal chlorides show that the frequency of the C-Cl bond is constant except in methyl chloride.

J. MASON

Department of Oil Engineering and Refining,  
The University, Edgbaston, Birmingham,  
Dec 9

<sup>1</sup> Mason and Wheeler, *Jour Chem Soc*, 2282, 1931

<sup>2</sup> Pease and Waltz, *J. Am. Chem. Soc.*, 3728, 1931

<sup>3</sup> Martin and Fuchs, *Zeit. für Elektrochemie*, 27, 150, 1921

<sup>4</sup> Harkins and Bowers, *J. Am. Chem. Soc.*, 2425, 1931. *Physical Review*, 33, 1845, 1931

<sup>5</sup> West and Farnsworth, *Trans. Faraday Soc.*, 27, 145, 1931

#### Preparation of Sulphuric Acid free from Nitric Acid

For the analysis of the nitrate content of sea water, and for certain tests on alkaloids, it is necessary to have sulphuric acid free from all but the most minute amounts of nitric acid. After testing a number of British and foreign samples of pure sulphuric acid, Harvey<sup>1</sup> reported that he had found the 'nitrogen free' sulphuric acid specially supplied by the British Drug Houses, Ltd., to be satisfactory, though the 'analytical reagent' acid was not so. Even in the purest acid the reduced strychnine reagent of Denigès demonstrated the presence of nitric acid, which was estimated by extrapolation after adding known amounts of nitrate, reckoned as milligrams of nitrate nitrogen per cubic metre of sea water.

Early this year I encountered the same trouble owing to nitric acid when applying the diphenyl benzidine method of Letts and Rea<sup>2</sup> to the estimation of nitrate in sea water. It was found, however, that all nitric acid could be removed from the sulphuric acid by the cautious addition of ammonium sulphide. It was later found preferable to use hydrogen sulphide. This reduces the nitric acid, and the amount of sulphur formed is too small to be visible or to render the acid even slightly turbid. In practice it is better not to remove all the nitric acid, but to leave a trace sufficient to give the faintest perceptible colour with the reagents. Excess of the reducing agent would, of course, render the test insensitive through the production of sulphur dioxide. The last supply of 'nitrogen free' acid received gave no perceptible colour with the reagent after standing for a day.

W. R. G. ATKINS

Marine Biological Laboratory,  
Plymouth, Dec 12

<sup>1</sup> *Jour. Marine Biol. Assoc.*, 14, 72, 1926

<sup>2</sup> *Jour. Chem. Soc.*, 105, 1157, 1914

#### National Needs.

I AM glad to have occasioned the rejoinder of H. E. A. in NATURE of Dec 26, though I am frankly horrified at his proposal for a *coup d'État* followed by the dictatorship of the Royal Society. I fear the adventure would end with that august body in the tumbrils.

H. E. A.'s other suggestion, that there should be inaugurated a kind of educational crusade to develop the scientific attitude of mind in the ordinary citizen, is one of the most important ever made to the world of science. In spite of the immense social importance of the work and temper of science, her disciples do not make any effort to explain themselves to the public comparable with the electioneering effort of a political party or the missionary effort of a church.

Something more is needed than gentle remonstrances addressed to schools and universities, begging them to include some science in the courses followed by their non-specialist students. Schools and universities are only part of the wider problem of the insufficiency of public thought to manifest social needs. I should like to see the scientific world dealing with the public mind by every modern device of persuasion, including school, university, press, radio, cinema, and the various institutions for adult education, in an organised attempt to influence the thought of this generation. I believe that such an effort, generously conceived and carried into effect, would be astonishingly successful.

I share the doubt, expressed in the leading article in the issue of Jan 9, as to the appropriateness of the Royal Society as a pivotal body for such a task. The Society could contribute the reflected glory of its immense prestige, but so far as I know it possesses no machinery for carrying out this kind of work.

The various concrete projects which peep out from time to time from beneath the generalities of the present discussion could be carried through by a comparatively small group of people, with the assistance of allies called into co-operation for special purposes. The members of such a group would need to be people of scientific training with a flair for public work and with the proper contacts within and without the scientific world. It would not be difficult to find a score of such men and women. The really difficult problem would be to finance their work. Such expenditure would in the end repay the scientific profession very handsomely in hard cash.

LOUIS ANDERSON FENN

Birmingham, Jan 5

#### Discovery of *Eurytemora thompsoni* at Lancing.

THE discovery of *Eurytemora thompsoni* by Mr Lowndes at Lancing<sup>1</sup> adds one more puzzle to the problem of the distribution of the fresh- and brackish-water fauna. A rather similar case of unaccountable distribution is that of *Acartia tonsa*, a copepod which was discovered in 1927 in brackish water in a canal at Caen (Normandy). This is a coastal species of very wide distribution, recorded from the Pacific, Indian Ocean, and North American coast of the Atlantic, but not from its eastern shores. In the case of the anemone, *Sagartia luciae*, the agency of ship transport is fairly obvious, but it is not very convincing for Calanoid copepods, especially when, as in the case of *E. thompsoni*, the locality has no connexion with any harbour. Still, such transport cannot be excluded. I have found *S. luciae* myself in a brackish pond in Norfolk far from any port.

It may be worth mentioning here that I specially looked for, and found, *S. luciae* in Port Said harbour, though it is not mentioned in the reports of the Cambridge expedition to the Suez Canal. Presumably the specimens were lost.

ROBERT GURNEY

Boars Hill, Oxford

<sup>1</sup> NATURE, 128, 967, Dec 5, 1931

## Research Items.

## Egyptian and Peruvian Mummies under the X-Rays.

—An X-ray study of the unopened Egyptian and Peruvian mummy-packs in the collections of the Field Museum of Natural History, Chicago, by Mr Roy L. Moodie, has yielded valuable material bearing on our knowledge of diseases in ancient times. An account of the investigation, accompanied by 76 plates, mostly from X-ray photographs, is published in vol 3 (Anthropology) *Memours* of the Museum. The employment of X-rays has made possible the examination of whole skeletons, but it is subject to limitations, of which the most serious is that it does not reveal all lesions, especially when they are slight or covered by more or less dense tissue. Nor does it show trepanning or injuries from clubs and the like. Percentage of disease or injury among the fifty-three mummy-packs examined is high, 10.52 per cent of the Peruvian pre-Columbian mummies and 40 per cent of the Egyptian being affected. The examination of the Peruvian children showed no evidence of rickets, but there is a trace among the Egyptians. The Egyptian mummies showed arthritis, arteriosclerosis, and absorptive osteitis resulting from pyorrhœa. Owing to the masses of pitch or sand-sprinkled tar which obstructs the head, and masks, ornaments, etc., the interpretation of the teeth is not possible. There is a doubtful case of hypertrophied liver. In the Peruvian mummies arthritis and arteriosclerosis are rare. Few cases of caries can be identified, owing to the intervention of various objects. Pyorrhœa and calculus are common. A rare example of impaction of the mandibular third molars was observed. Nasal disturbances of the turbinates was revealed, though none is sufficiently clear to admit diagnosis. Aural exostoses were a frequent cause of partial or complete deafness. Otitis media occurred, and mastoid infection was detected. Mummified animals from both Egypt and Peru were also examined.

**Habits of Californian Red Tree Mouse**—The red tree mouse, *Phenacomys longicaudus*, builds its nest as a rule amongst the branches of a Douglas fir or a great fir (*Abies grandis*), but this seems to be simply because it finds there suitable support in proximity to a rich food supply consisting of the green leaves of the fir trees. In eating these leaves, the mice show a curious habit, described by Seth B. Benson and Adrey E. Borell (*Jour. Mammalogy*, vol 12, Aug 1931). The needle, bitten off a twig, would be held in both fore paws, then a stripping process commenced, the outer side of the needle being shredded off from base to tip, as it was passed from right to left. Then the needle would be reversed and turned over, and the mouse, passing the leaf from right to left as before, would start at the apex and strip off the other edge of the needle. Thus the resin ducts, placed in the margins of the leaf, were got rid of, and the remaining edible portion, held in the left fore paw, was eaten as one would eat a stalk of celery. That the object of the stripping was to remove distasteful portions of the leaf was indicated by the habit of the mice of eating, without preliminary treatment, very young needles in which resin ducts were not fully formed. They were never seen to eat the resin duct portions and discard the medullary portion of the needle.

**Wild Sheep Hybrid**—In 1906 and later, a few Mouflon sheep, described as from Sardinia and Corsica, were introduced by Lord Revelstoke on Lambay Island, Co. Dublin, and bred there successfully, increasing for a number of years. Some were shot during the War, and by 1927 two males only were left alive. A large flock of Black Welsh Mountain

sheep were free on the island at the same time, but no interbreeding took place while there were any Mouflon ewes alive. Dr J. A. Fraser Roberts (*Jour. Genetics*, vol 25, no 1) has made a study of the later crosses, after carefully describing the Mouflon coat. In the years 1928-29, twenty-eight  $F_1$  lambs were born, 15 self-blacks, 8 black reversed badger-faces, and 5 whites.  $F_2$  and back-crosses are also described. The results show that the Mouflon is a recessive black, bearing the factor for reversed badger-face pattern. Nine other factors are shown to be absent: dominant black, dominant brown, white, badger-face, black head, white collar, the factor or factors for grey colour, and the two factors that give coloured or spotted faces and legs in a white sheep. Photographs are given of some of the hybrids and of several wild species of sheep. The paper concludes with notes on the coat colours of various wild species. The Mouflon has the darkest pattern of any except the Himalayan Bharal. The undercoat in all is brown, or white, not black, and all members of the Mouflon and Urial groups show reversed badger-face pattern. The Barbary sheep of North Africa is reddish fawn self-coloured, without this pattern.

**Deep Sea Fishes**—Mr Albert Eide Parr in two papers published in the *Bulletin of the Bingham Oceanographic Collection*, Peabody Museum of Natural History, Yale University, vol 2, Art 4, and vol 4, Art 1, October 1931, revises the classification of a number of deep sea fishes and gives useful keys for their identification ("Deep Sea Fishes from the Western Coast of North and Central America" and "A Practical Revision of the Western Atlantic Species of the Genus *Cutharichthys* (including *Etropus*)"). Among the fishes described in the first paper there are many interesting new forms. The new genus *Dolichodon* is suggested for Norman's *Dysalotus macodon* and a new species named *Dolichodon normani*. These differ from *Dysalotus*, here restricted to having only two rows of teeth in each jaw, the inner series sharply differentiated from the outer by an abrupt and very great increase in the size of its teeth and by their strong curvature. In the second paper, there are special observations on *Cutharichthys crossotus* from both the Atlantic and Pacific side of central and southern North America. The author was unsuccessful in differentiating the full grown individuals, but shows that there is a considerable difference in the relative body widths with increasing size, the Atlantic specimens only showing a very slight indication of a gradual increase in relative width with increasing size, whilst those from the Pacific show a very marked and consistent difference. A new subspecies is based on this difference, the two forms being named *Cutharichthys crossotus atlanticus* and *Cutharichthys crossotus crossotus*. There are very distinct secondary sexual characters in *Cutharichthys unicornis*. The young males less than 35 mm. are like the females outwardly, but very soon the width of the interorbital space in the male rapidly increases and also there is a great development of cephalic spines.

**Genetics of the Dahlia**—The common dahlia, *D. variabilis*, is well known to show great variability. Mr W. J. C. Lawrence has brought forward further evidence (*Jour. of Genetics*, vol 24, No 3) that it is an octoploid species (with sixty-four chromosomes) produced by the crossing of two tetraploid species, one carrying factors for ivory and magenta flowers, the other for the yellow-orange-scarlet series. Several species are found to have thirty-two chromosomes and one (*D. Merckii*) thirty-six. From a study of the

various pigments and their inheritance, it is suggested that the yellow flavone colour is determined by a factor (*Y*) which is tetrasomic and segregates at random, while the ivory factor (*I*) gives disomic ratios only. Flavone inhibitors are also present, as well as anthocyanin factors—*A*, paler and cumulative in effect when present in multiple, *B*, deeper and probably also cumulative. The genetic evidence indicates that *I* and *Y* are carried by homologous chromosomes derived from different ancestral species. Similarly, *A* and *B* are carried by two differentiated quadrivalent sets of chromosomes, which probably underwent their chemical differentiation parallel respectively to *I* and *Y*. It is further suggested that the tetraploid species have been derived from a diploid ancestral stock in which the two flower-colour series differentiated. In *D. variabilis*, secondary chromosome associations of four or more chromosomes are found in meiosis, and in crosses with *D. coronata* ( $2n=32$ ) many of the *coronata* chromosomes pair with *variabilis* homologues, indicating that *coronata* is perhaps one of the ancestors of *variabilis*.

#### Tuber Indexing for controlling Potato Virus Diseases

—The production of stocks of potatoes free from virus diseases is an urgent problem. Large sums of money are lost annually by the potato-growing community through the depredations of crinkle, mosaic, and leaf-roll. It seems that any method of ensuring freedom from these maladies would turn potato-growing from being somewhat of an incubus to an economic success. Americans for many years have practised the cutting-out of a small part of a tuber containing an eye, which is grown in a warm greenhouse in winter. The state of health of the plant thereby produced shows whether the original tuber (which is afterwards planted in the field) was infected with any virus disease. A report by J. E. Kotila (*Michigan State College Tech. Bull.*, No 117, 26 pp., 1931) has recently been published. This shows that the method of tuber indexing works well on a large scale in Michigan, so far as the production of disease-free clones is concerned. Such testing must be followed by adequate isolation of the improved stocks from diseased crops. The report is rather disappointing, however, in that there are too few comparative yields of unimproved stocks. The high summer temperatures of the middle-west States mask the symptoms of virus diseases and cause less reduction in yield than would occur in cooler climates. Masking takes place in Great Britain only when summers are hot, there was little masking last year. If tuber indexing gives good results in America, would it not give better results in Great Britain, where reductions in yield by the diseases are more serious than in the United States?

**Water in Granitic Magmas**—The results of an important investigation by R. W. Goranson on the solubility of water in granite-glass (*a*) as a function of pressure from 500 bars to 4000 bars at 900° C. and (*b*) as a function of temperature from 600° to 1200° C. at 980 bars, are presented in the *Amer. Jour. Sci.* for December 1931. The granite-glass was obtained by melting the normal biotite-bearing muscovite-granite of Stone Mountain. The solubility of water in this glass at 900° C. increases from 3.75 per cent at 500 bars to 9.35 per cent at 4000 bars. The solubility at 980 bars decreases by 0.3 per cent per 100° C. rise in temperature over the range 600°–1200° C. Essentially the same results were found in the case of a natural rock-glass (obsidian) from Mount Kiamis, Japan. It is concluded that natural glasses with 8–10 per cent of  $H_2O$  + should be extremely rare, and this is shown to be borne out by published analyses of fresh obsidians. Reasons are presented for consider-

ing that granitic magmas may have had a relatively high water content, and that such water would have an important effect in lowering the crystallisation temperatures. At 10 km depth and 1000° C., the amount of water held in solution could be as much as 6 per cent. If the magma could ascend between impervious walls, the solubility would fall and the excess water would accumulate until the overlying rocks became incompetent to withstand the pressure. Rupture would then take place with explosive force, and lead to the development of volcanic phenomena.

**Earthquakes of the Channel Islands**—Though among the strongest that are felt in the British Isles, the earthquakes of the Channel Islands have not received the attention that they deserve. In a memoir recently published by the Société Jersiaise, Mr. A. E. Mourant has thus well supplied a long-felt want. The list of all the known earthquakes since the year 824, contains four (in 1799, 1878, 1889, and 1926) that must have disturbed areas of more than 115,000 sq. miles, an area greater than that of any earthquake of strictly British origin. The earthquakes since 1926 have been investigated by the author, and of these more detailed accounts are given, especially of those of July 30, 1926, and Feb. 17, 1927. The stronger shocks have certain characteristics in common. Most of them originated in a focus in lat. 49° 11' N., long. 1° 42' W., or about nine miles east of St. Helier, thus nearer to France than to Jersey. They tend to recur at regular intervals of 12 yr. ± 7 mon., while an examination of all the Jersey earthquakes, great and small, shows some evidence for periods of four years and one year.

**Thermal Conduction in an Electric Field**—The *Zeitschrift für Physik* for Oct. 30 contains an account of experiments performed by W. Bonwitt and G. Groetzinger at Vienna, which show that heat losses in a gas are changed to a slight extent by an electric field. The method used was that in which a wire supported in the gas is heated electrically, and the equilibrium temperature which it assumes under the influence of the electric current and thermal loss through the gas is measured from its resistance. Air and carbon dioxide give only a very small effect, but it is much larger and can be readily followed with certain organic vapours. With acetone vapour at a pressure of 175 mm. of mercury, for example, a decrease of one-tenth of a degree in the temperature of the wire was recorded in a field of 1000 volts per cm. The magnitude of the effect depends upon the dielectric constant of the gas, increasing rapidly with the permanent electric moment of the molecule, and its sign always corresponds to an increase of thermal conductivity in the field.

**Photographic Photometry**—In view of the many applications of the measurement of the blackening of photographic plates for photometric purposes, it is disturbing to find in a paper by P. C. Keenan in the September issue of the *Astrophysical Journal* that large errors may arise if the time between exposure and development is not standardised. It appears that the effect is somewhat erratic, depending upon a variety of conditions, but what is generally observed is that the latent image increases in intensity for a few hours after exposure and then tends to fade off again. In the tests which are described, increases of density of the order of ten per cent were found to occur after two hours, the increase being greatest for moderately strong blackening. It is concluded that although the effect is normally likely to be quite small, yet in exceptional cases it may be important, so that in photometry which aims at any considerable degree of precision, images of which the densities are to be

compared directly should be developed at as nearly the same time after exposure as possible

**A Possible Hydrogen Isotope of Mass 2**—There is some evidence from atomic weight determinations that hydrogen should have isotopes of masses 2 and 3. If they exist, it can be shown from thermodynamical reasoning that molecules of the types  $\text{H}^1\text{H}^2$  and  $\text{H}^1\text{H}^3$  should concentrate relative to the common  $\text{H}^1\text{H}^1$  molecules in residues from the evaporation of hydrogen near the triple point, whilst it is known from simple spectroscopic theory that the heavier atoms would have a displaced Balmer spectrum. Work undertaken on these considerations is reported by H. C. Urey, F. G. Brickwedde, and G. M. Murphy in the last issue of the *Bulletin of the American Physical Society* for 1931. The atom  $\text{H}^3$  has not been detected, but it has been found that the lines  $\text{H}\beta$ ,  $\text{H}\gamma$ , and  $\text{H}\delta$  are accompanied by weaker lines which agree within the experimental error of 0.01 Å with the positions calculated for an isotope of mass 2. The reputed isotope lines have the same width as the main lines and are definitely more intense with the treated material, although they are present when ordinary hydrogen is used.

**Chromium Plating**—The chromium plating now so much used to prevent tarnishing of metal fittings of all kinds has been found to be slightly porous and not to afford sufficient protection against corrosion of the base metal, such as steel, on which it is deposited. It has been necessary to deposit copper or nickel on the base metal before the chromium is applied, and the Bureau of Standards, in co-operation with the American Electroplaters' Society and the American Society for Testing Materials, has been investigating the possibility of producing less porous deposits and so reducing the thickness of the copper or nickel protection necessary. The results are summarised in a paper by Messrs W. Blum, W. P. Barrows, and A. Brenner in the October issue of the *Journal of Research* of the Bureau. Both the porosity and the cracking of the chromium deposit increase rapidly in the first twenty-four hours and more slowly for several weeks at room temperatures. Heating for a short time to 200° C increases the ultimate cracking. A slight increase in the chromic acid and of the ratio  $\text{CrO}_3$  to  $\text{SO}_4$  in the depositing tank, an increase of

temperature of the tank to 55° or 65° C and a decrease of current density, all decrease the porosity of the deposit.

**Purification of Radon**—G. H. Henderson, in the *Canadian Journal of Research*, p. 466, describes a simple apparatus for the purification of radon for radium therapy, which differs in some respects from the ordinary practice. Potassium hydroxide is used to remove carbon dioxide and most of the water, and since phosphorus pentoxide is dispensed with, only one Toepler pump and fewer valves and stopcocks are necessary. The impurities are removed by sparking and the excess of hydrogen is allowed to escape through an electrically heated palladium tube. The apparatus, which was designed by W. G. Moran, has been in use in the Victoria General Hospital, Halifax, for three years with very satisfactory results. The radon is readily concentrated to 100 millicuries per cubic millimetre, the actual purification taking from two to five minutes. The amount of radium in solution in the apparatus is 200 mgm, but there seems no reason why it should not work equally well with larger quantities.

**Vitamin B and Phytase**—Since Teru-Uchi has shown that experimental beri-beri of pigeons (avitaminosis B) is caused by the action of a toxic substance, orizotoxin, extractable from polished rice, and Iwata has found that lysocitin, a substance formed from lecithin by the action of certain enzymes, occurs in polished rice, the possibility of a relationship between lysocitin and orizotoxin arises. A series of experiments made by Cuboni and described in the *Rendiconti of the Reale Istituto Lombardo di Scienze e Lettere* (vol. 64, parts 11-15, 1931) shows that all the symptoms of beri-beri may be reproduced in chickens by injections of orizotoxin, whereas injection of lysocitin has no such effect. Various analogies in behaviour between phytase—which, as Belfanti and Contardi showed, prevents and cures beri-beri—and vitamin B are pointed out, and the conclusion is drawn that these two substances are certainly closely related and probably identical. Further similarity between phytase and vitamin B is revealed by experiments—described in the same issue—carried out by Arnaudi, who finds that the growth of yeast and certain other micro-organisms is accelerated in the same way by the two substances.

### Astronomical Topics.

**The Orbit of 61 Cygni**—This well-known double star has always attracted much attention from the wide distance between the components and the large proper motion, it was for the latter reason that Bessel selected it for parallax tests with the Königsberg heliometer, obtaining the first reliable stellar distance. Though it is such a near neighbour, the period is so long that its determination has baffled many investigators. In fact, at the end of the last century some American astronomers denied that it was a binary at all. However, M. T. Lewis, in his memoir on the Struve double stars, gave a diagram on a large scale of the observations up to 1900, which exhibited the curvature of the path in a palpable manner. At an even earlier date Dr. Peters had published an orbit in *Astr. Nach.*, with a period of nearly eight hundred years.

Mr. Fletcher read a paper on this star at the January meeting of the Royal Astronomical Society. He considers the binary character absolutely established, and anticipates that the period would be found to lie between 700 years and 1000 years, agreeing with the estimate of Peters. In the discussion, Dr. Jackson pointed out that the uncertainty in the period

does not introduce much error into the determination of the masses, as this depends in the main on the curvature of the arc over which the observations extend. Mr. Fletcher also considered the observations of radial velocity of the components, but as the difference between them is small, they do not add much to the accuracy of the orbit-determination.

**Possible Early Observation of the Bielid Meteors**—*Pop. Astr.* for December contains a translation by Willard J. Fisher of an article by W. Klinkerfues that appeared in *Göttinger Nachrichten*, April 3, 1873. It is evidently very little known among astronomers. It establishes with great probability, on the basis of a record by Theophanes, that Biela's comet and the accompanying meteors were both observed at Byzantium in the year A.D. 524. It is noted that the record mentions both comet and meteors together, so that a connexion between them was suspected even then. Klinkerfues also concluded that the comet observed in China in November A.D. 1162 was Biela's. In both the years mentioned the comet, if correctly identified, would have been near the earth, so that its visibility with the naked eye is not improbable.

## Prize Awards of the Paris Academy of Sciences.

AT the annual meeting of the Paris Academy of Sciences, the prizes and grants awarded for the year 1931 were announced as follows

*Mathematics*—The Francœur prize to Jacques Herbrand, for his work on the theory of bodies of numbers

*Mechanics*—The Montyon prize to Hippolyte Parodi, for his work on the electrification of railways and on ballistics, the Poncelet prize to Henri Chipart, for his work in mathematical physics and mechanics

*Astronomy*—The Lalande prize to Irénée Lagarde, for work relating to astronomical calculations, the Valz prize to Henri Chrétien, for his work in astronomical optics, the G de Pontécoulant prize to Jean Chazy, for his work in analytical and celestial mechanics

*Geography*—The Gay prize to Henri Roussilhe, for his work on the use of aerial photography in topographical surveys on the large scale, the Tchihatchef prize to Charles Crevost and Alfred Pételot, the two authors of vol 5 of the catalogue of the products of Indo-China (medicinal products), the Alexandre Givry prize to André Gougenheim, for his work in hydrography

*Navigation*—The Prix de la Marine between Eugène Burlot (3000 francs), for his theoretical and experimental studies on explosives, Charles Bertin (1500 francs), for his method of marine and aerial navigation, and Gabriel Voitoux (1500 francs), for his book on trans-Atlantic aerial navigation, the Plumey prize to Marcel Edmond Gautier, for his memoirs dealing with combustibles used in Diesel motors

*Physics*—The Kastner-Boursault prize to Francis Perrin, for his work on fluorescence, the Gaston Planté prize to Émile Pierret, for his researches on high frequency electromagnetic waves, the Hébert prize to Gustave Ribaud, for his treatise on pyrometry, the Henri de Parville prize to Georges Darrieus, for the whole of his work in electrotechnics, especially the calculations on high tension lines, the Hughes prize to René de Mallemann, for his work on magnetic rotatory polarisation, the Pierson-Perrin prize to Georges Reboul, for the whole of his researches on the properties of semi-conducting substances, the Clément Félix foundation to Mlle Madeleine Chenot, for the continuation of her researches on the high frequency discharge in rarefied gases

*Chemistry*—The Montyon prize (unhealthy trades) to Léon Brunel, for his contributions to various important problems of public hygiene, and an honourable mention (1500 francs) to Georges Champetier, for his work on the protection of civil populations against mustard gas, the Jecker prize to Ernest Fournéau, for the whole of his work in organic chemistry, the Cahours foundation between Arthur Brunel, for his work on plant ferments, and Jean Dœuvre, for his studies on citronellol and rhodinol, the Houzeau prize to Henri Marcelet, for his work as a whole

*Mineralogy and Geology*—The Delesse prize to Léon Carez, for his geological work on the Pyrenees, the Victor Raulin prize to Eugène Raguin, for his geological work in the Alps and the Central Massif, the Joseph Labbé prize to Lucien Thiébaud, for his work on the clay-limestone sediments of the Paris basin

*Botany*—The Desmazières prize to Gaston Ollivier, for his work "Étude de la flore marine de la Côte d'Azur", the Montagne prize to Pierre Frémy, for his memoir on the Myxophyceæ of French Equatorial Africa, the Jean Thore prize to Georges Deflandre, for his monographs on *Trachelomonas* and *Arcella*, the Fons Méhœcq prize to Jean des Cilleuls, for his work

on the plankton of the Loire the de Comcy prize to Adolphe Prunet, for his work on the diseases of the chestnut tree, the Jean Rufz de Lavison prize to Émile Michel-Durand, for his memoirs on the variation of the carbohydrate substances in leaves and on the tannic compounds

*Anatomy and Zoology*—The Cuvier prize to François X Lesbre for the whole of his work on comparative anatomy, morphology, and teratology of mammals, the Savigny foundation to Robert Dollfus, for his work in the Red Sea and Suez Canal

*Medicine and Surgery*—The Montyon prizes A Montyon gold medal to Edoardo Peironcito, for the whole of his scientific work Prizes of 2500 francs to Maurice Auvray, for his memoir on diseases of the skull and brain, to Henri Chabanier and Carlos Lobo-Onell, for their memoir on functional exploration of the kidneys, to Maurice Villaret, François Saint-Girons, and Louis Justin-Besançon for their memoir on the physiological, clinical, and therapeutic study of peripheral venous pressure

Honourable mentions (1500 francs) to Émile Césari, for his researches on the antigenic function of the lipoids, Paul Géraud, for his researches on the exchanges of ions between yeast cells and saline solutions, Mme Mélna Lipinska, for her memoir on women and the progress of medical science

The Barbier prize to Casimir Peirier, for his contribution to the study of the oil-bearing plants of the Cameroons, the Breant prize between (2500 francs each) Maurice Langeron, for his studies on the pathogenic fungi, and Pierre J Teissier and Florent Coste, for their book on the physio-pathology of scarlet fever, the Godard prize between (500 francs each) Louis Berger, for his memoir on the internal secretion cells in the sexual glands in man and woman, and Fritz Busser, for his book on epithelial tumours of the kidney in the adult the Chaussier prize to Victor Morax, for the whole of his medical work, the Mège prize to Jean Gautrelet, for his work on the influence of adrenalin on the variations of the alkaline reserve, the Bellion prize to Raoul Lecocq, for his book on food and life, the Larry prize to Maurice Pilod, for his studies on tuberculosis, Louis Izard and Jean des Cilleuls receiving an honourable mention for their book on military hygiene, the Argut prize to Pierre Ernest Roucaÿrol, for his memoir on direct 'd'arsonvalisation' in the treatment of blennorrhagia

*Physiology*—The Montyon prize to Charles Dhéré, for his studies on biological fluorescence, the Pourat prize (in equal parts) between Maurice Fontaine, for his experimental researches on the reaction of living beings to high pressures, and Fernand Obaton, for his memoir on the evolution of mannitol in plants, the Philpeaux prize to Robert Bonnet, for his work on metabolism

*Statistics*—Montyon prizes (1000 francs) to Pierre Caloni, for his memoir on the statistics of accidents and organisation for their prevention, and to Jean Fischer, for his statistical studies of the rivers Adour, Garonne, and Gironde

*History and Philosophy of Science*—The Binoux prize to Louis de Nussac, for his book on "Pierre Andre Latreille"

*Works of Science*—The Henri de Parville prize between Émile Guyénot (2500 francs), for his books on variation, evolution, and heredity, and Paul Dorveaux, for his researches on the members and correspondents of the Royal Academy of Sciences, 1666-1793

*Medals*—The Berthelot medal was awarded to Henri Marcelet



*General Prizes*—The Grand prize (physical sciences) to Paul Fallot, for his geological work in the Balearic Islands, Andalusia, and Morocco, the Bordin prize to René Garnier, for his work on the problem of Plateau, the Lallemand prize to Albert Chauchard and Mme Berthe Chauchard, for their physiological researches on the sympathetic and parasympathetic nervous system and on the brain, the Maujean prize to Gustave Bouffard, for his work on tropical diseases, the Petit d'Ormay Prize (mathematical sciences) to Gaston Julia, for the whole of his mathematical work, the Petit d'Ormay prize (natural sciences) to Pierre Lesne, for his entomological work, the Jean Reynaud prize to the late Paul Appell, for the whole of his scientific work, the Baron de Joest prize to Gustave Hinard, for his work on sanitation and oyster culture, the Parkin prize to Marius Dalloni, for his work in connexion with the expedition to Tibesti, the Santour prize to Henri Devaux, for his work on the properties of thin layers deposited on the surface of liquids, the Lonchampt prize to Eugène Derrien, for his work in biochemistry, the Henry Wilde prize to Edmond Rothé, for his geophysical work, the Gustave Roux prize to Henri Bésairie, for his work on the geology of Madagascar, the Thorlet prize to Adolphe Richard.

*Special Foundations*—The Lannelongue foundation to Mmes Cusco and Ruck, the Hélène Helbronner-Fould prize to Mme Marc Bel, in recognition of the exploratory work done by her late husband.

*Prizes of the Grands Écoles*—The Laplace prize to Jean Latourte, the L. E. Rivot prize between Jean Latourte, Albert Gabriel Bureau, Jean Gaston Chauchoy, and Alphonse Desiré Charles Louis Cachera.

*Foundations for Scientific Research*—The Trément foundation to Maurice Lebrun, for his work on electric welding, the Gegner foundation to Eugène Estanave, for his work on photography, the Hirn foundation to Yves Milon, for geological and palæontological work in Brittany, the Henri Becquerel foundation to Edgar Pierre Tawil, for his work in piezo-electricity.

#### THE LOUTREUIL FOUNDATION

The Academy has made the following grants from this fund

1 *Researches on Definite Problems*—Julien Costantin (3000 francs), for researches on applied botany in the Alps, Gabriel Marotel (2000 francs), for experimental researches on the disease of the fluke worm and its treatment, A. Aron (2000 francs), for prosecuting researches on the properties of thin metallic plates, James Basset (500 francs), for laboratory researches on the influence of high pressures on physical and chemical phenomena, Claude Gautier (1000 francs), for

work on the physiological synthesis of the proteins, Charles Marie (3000 francs), for researches on the ammonia-oxygen gas battery, Raymond Ricard<sup>4</sup> (2000 francs), for spark spectra of metals by means of electrodeless discharges, Gaston Delépine (10,000 francs), for the continuation of work commenced by him and by his pupils, especially on the Carboniferous of Asturia, Abel Gruvel (2000 francs), as a contribution to his scientific and applied researches on the fauna of the hydrographic network of Syria.

2 *Purchase of Maternal*—Emilio Damour (2000 francs), for the purchase of an apparatus controlling combustion by thermal conductivity, René Dubrisay (5000 francs), for the purchase of a microscope, Augustin Mesnager (2000 francs), to contribute to the purchase of an apparatus for measuring the distribution of the stresses in various elastic solids, Casimir Monteil (5000 francs), for the purchase of a Jacquet tachygraph.

3 *Libraries*—École polytechnique (10,000 francs), for the library, École nationale vétérinaire d'Alfort (10,000 francs), for its library, École nationale vétérinaire de Lyon (13,000 francs), for assisting the replacement of the library destroyed by fire, École nationale vétérinaire de Toulouse, for its library.

4 *Publications*—"Faune des Colonies françaises" (5000 francs), for its publications, Albert Peyrot (6000 francs), for the completion of the "Conchologie néogénique de l'Aquitaine", Section of Terrestrial Magnetism and Atmospheric Electricity of the National Committee of Geodesy and Geophysics (6000 francs), for the publication of charts of magnetic anomalies in France, Georges Perrier (10,000 francs), for the calculations contained in the publication dealing with latitudes by meridional observations of the Mission de l'Équateur, Ministry for the Colonies, Service central de la Météorologie coloniale (15,000 francs), for starting a publication on the scientific observations made in the French overseas dominions, Office international de Documentation et de Corrélation pour la Protection de la Nature (2000 francs), for the publication of leaflets concerning the French colonies, Mme Victor Noury foundation, between Paul Vignon (3000 francs), for his introduction to experimental biology, Raymond Decary (2500 francs), for his work entitled "L'Androy", the late Gabriel Grimaud (2500 francs), for his book on the Rohan-Chabot expedition, and Jehan Albert Vellard (2500 francs), for his studies of the poisonous spiders of southern Brazil, the Charles Bouchard foundation to Serge Metalnikov, for his memoir on the rôle of the conditional reflexes and of the nervous system in immunity, the Roy Vaucouloux foundation to Antoine Lacassagne, for his work on the action of radiations on healthy and cancerous tissues.

#### Measuring Atmospheric Pollution.

AT the present time, the investigation of atmospheric pollution—conducted in Great Britain by the Department of Scientific and Industrial Research through the agency of a Research Committee—is mainly carried out with the aid of three instruments, all designed by Dr J. S. Owens, Superintendent of Observations to the Committee. The first, known as the deposit gauge, is designed for the purpose of measuring the total amount of impurity deposited on a given area. It consists essentially of a rain-gauge, in which the ordinary copper collecting funnel is replaced by a large glass receiver. The rain, with the impurity, is collected for a definite period, usually a calendar month, and then analysed. The second and third instruments are respectively the automatic air filter and the jet dust counter. The former gives a semi-con-

tinuous record of the concentration of suspended impurity in the atmosphere. The latter provides a means of determining the number of solid particles in a given volume of air and of ascertaining the physical nature of the individual particles. Dr Owens has recently made important improvements to both these instruments, and, although no new principles are involved, their range of usefulness has been very greatly extended.

In the automatic air filter a known volume of air (actually two litres in standard instruments) is drawn at intervals into the apparatus through a nozzle,  $\frac{1}{8}$  in. in diameter, over which is pressed a piece of white blotting paper. In passing through the blotting paper the suspended impurity is filtered out and a darkened spot, varying in shade according to the concentration

of the impurity, is left on the blotting paper. From the results of a long series of preliminary experiments with large volumes of air, it has been possible to construct a scale of shades each representing a definite number of milligrams of impurity per cubic centimetre. The reading of the record thus consists in matching the spot against a corresponding shade in a numbered scale, an operation which can be done quite readily with sufficient accuracy. The spots are obtained in succession round the edges of the blotting paper, which is in the form of a circular disc, rotated once in twenty-four hours and controlled by clock-work.

In the earlier form of the instrument the mechanism for drawing in the air was operated by water entering a vessel provided with a syphon, which caused the water to rise and fall between two fixed levels. During the fall, air was drawn through the filter disc, an arrangement being provided for making an airtight joint between the filter nozzle and the air inlet pipe during this operation. During the rise, the filter disc was unclamped and rotated to a point fixed by the clock, the filtered air being meanwhile expelled by the rise of water in the main vessel. This form of apparatus had certain disadvantages, of which the present writer can speak feelingly as a former Superintendent of the Instruments Division of the Meteorological Office, where one of these instruments is working. The necessity for a continuous water supply is a serious drawback, and experience has made it obvious that improvements were necessary in other features of the instrument.

In the new design, the filtering mechanism is operated entirely by a falling weight which is wound to the top of its travel once a day. No outside source of power is required, and the installation of the instrument is thus not restricted to sites where these are available. The descending weight operates a crank through a train of gearing, and this crank is connected to a reinforced rubber bellows, so that at each revolution the bellows is expanded and contracted. On the down stroke one litre of air is drawn in very slowly through the filter disc, which is gripped meanwhile between the top of the filter nozzle and a corresponding 'nose' above the paper. On the up stroke air is

expelled from the bellows, the filter nozzle being meanwhile lowered out of contact with the paper. By means of an ingenious auxiliary clamping device operated by cams, the paper can be held in the same position while air is drawn in on one, two, four, or eight successive revolutions of the crank. In this way the volume of air contributing to each spot may be varied from one to eight litres, to suit the locality and season. This feature is, in my opinion, one of the chief advantages of the new instrument.

In the jet dust counter a sample of the air to be examined is caused, by means of a pump, to pass through a narrow slit behind which is a clean microscope cover glass. Before entering the slit the air passes through a cylindrical 'damping chamber' lined with wet blotting paper, and the velocity in the jet is such that a fall of pressure takes place and condensation occurs as a result of the adiabatic cooling. The water droplets and dust particles strike the cover glass, the dust adheres, and the water evaporates. In this way the dust in a known volume of air is obtained in the form of a narrow ribbon-like deposit on the cover glass, which can be examined quantitatively and qualitatively under a microscope. In the older apparatus only one record could be obtained on each glass, and, as several operations are involved, it was distinctly troublesome to get a series of records, for example, in different rooms of a building. In the new instrument, which has been put on the market by Messrs C. F. Casella and Co., Ltd., the cover glass is carried on a rotatable head which can be operated from the back of the instrument. A two-way tap also is provided, by means of which the jet can be put out of action while the damping chamber is being flushed with the new sample of air. By the aid of these devices a series of, say, eight or ten separate records can be obtained on a single cover glass, the lines of deposit intersecting at the centre like the spokes of a wheel. With a suitable eyepiece and objective in the microscope, a rough preliminary comparison of the records can be made by inspection, since portions of two or more records can be brought into the field of view simultaneously. In this way the scope of the instrument has been greatly extended and the ease of manipulation much improved. E. G. BILHAM.

### Importation of Scientific Specimens and Apparatus into Great Britain.

AS the result of a report by the Association of British Zoologists, the Council of the British Association in February 1931 appointed a committee to consider action with the view of the amelioration of the customs regulations affecting the importation of scientific specimens and apparatus. Following upon discussion between officers of the Association and the Customs House authorities, the latter have most kindly supplied the Association with a memorandum on the reliefs from customs duties on scientific instruments and cinematograph films, and from the import prohibitions on plumage likely to be of use to scientific workers, together with a note on procedure in respect of the importation of scientific specimens preserved in spirit.

The memorandum on scientific instruments and cinematograph films was supplied confidentially to enable the Association to advise *bona fide* scientific workers, but not for general publication, since some of the relaxations are extra-statutory and liable to modification or withdrawal as the interests of the revenue may demand. The British Association is, however, prepared to advise on specific applications from scientific workers or societies. Inquiries should be addressed to the Secretary of the British Association at Burlington House, London, W. 1.

It clearly emerged in the course of discussion that some of the difficulties which have been encountered by scientific workers under the customs regulations might have been avoided by previous communication with the Board of Customs and Excise, Custom House Lower Thames Street, London, E. C. 3.

The procedure with regard to the importation of scientific specimens in spirit which will apply in future is as follows.

It will be necessary that the person by whom the specimens are imported into Great Britain (or the person or institution to whom they are addressed, in the case of specimens dispatched by a consignor abroad) should be formally authorised to receive spirits free of duty for use in an art or manufacture, under the provisions of the Finance Act, 1902, Section 8. Where, however, the importer or consignee does not already hold such an authority, the collector of customs and excise at the port of importation will grant it, subject to the conditions in the next paragraph.

If the specimens are imported as ship's cargo, the necessary customs entry must describe them as specimens preserved in spirits, with a sufficient description of their nature and the approximate quantity of spirits, and must show the name and address of the importer or consignee. With the entry must be produced

letters or other documents sufficiently establishing the status of the importer or consignee and the purposes for which the specimens are imported. The collector of customs and excise will be at liberty to request further information, if he considers it necessary. Where specimens are imported in personal baggage, similar information will be asked for.

If these requirements are satisfactorily complied with, the necessary authority will be granted forthwith and the specimens admitted immediately free of any charge of spirit duty.

It is not necessary that scientific workers proceeding on expeditions abroad should take any action before leaving Great Britain. It is, however, advisable, with the view of avoiding delay, that scientific workers returning with specimens should have the letters or other documents required to establish the facts readily available, and, in the case of specimens which are being received from senders abroad, that the forwarding agent who is entrusted with the work of clearing the goods should be supplied with the necessary information and letters, etc., in good time.

### University and Educational Intelligence.

LONDON.—The following honorary appointments to the staff of the London School of Hygiene and Tropical Medicine are announced.—Dr James Fenton, medical officer of health for the Borough of Kensington, to be an additional lecturer on public health administration and practice, Mr L. W. G. Malcolm, conservator of the Wellcome Historical Medical Museum, to be a lecturer on racial hygiene.

A COURSE of nine lectures on television will be given by Mr J. J. Denton, honorary secretary of the Television Society, at the Borough Polytechnic, Borough Road, London, S.E. 1, on Thursdays at eight o'clock, commencing on Jan. 21. Further information can be obtained from the Principal of the Polytechnic.

THE finance of public elementary education as exemplified, on one hand, in certain Tyneside areas and, on the other, in a number of wealthy watering-places, forms the subject of a pamphlet entitled "The Finance of Public Elementary Education", by Mr Ernest Dyer, issued in November by the Tyneside Council of Social Service (17 Ellison Place, Newcastle-upon-Tyne). The gist of the problem discussed is indicated in the following comparison between Hebburn and Bexhill urban districts. In 1929-30 Hebburn (a Tyneside town) had 4683 elementary school children and a *ld.* rate yielded £395 or 1s. 8½*d.* a child, so that an education rate of 3s. 2*d.* in the £ was needed to finance an expenditure of £8 19s. 9*d.* per child. Bexhill, with an equal population, had only 1339 elementary school children, a *ld.* rate yielded 16s. 8½*d.* per child, and a rate of 7½*d.* in the £ (one-fifth of the Hebburn rate) enabled it to spend £13 3s. per child (fifty per cent more than Hebburn expenditure). The following year, under the operation of the Derating Act, Hebburn's rate had to be raised from 3s. 2*d.* to 4s. 7*d.*, while Bexhill's position remained unchanged. The conclusion drawn is that the formula under which grants-in-aid are fixed is becoming increasingly ineffective as a means of rectifying such disparities between rich and poor authorities, and there can be no satisfactory advance in education in the poorer districts, such as those of the Tyneside, until the State can be persuaded to accept a greater share of financial responsibility. The conclusion is to some extent invalidated by a number of important recent modifications of the grants-in-aid rules. A summary of these is given at the end of the paper.

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### Calendar of Geographical Exploration.

#### Jan 17, 1773.—Crossing the Antarctic Circle

In the sixteenth and seventeenth centuries there was a widespread belief in the existence of a great southern world. The revival of interest in geography in the eighteenth century led the Royal Society to urge on the British Admiralty the importance of research in southern waters. In 1768, James Cook sailed under orders of the Admiralty to prosecute astronomical and geographical researches in the Southern Pacific. In July 1772, under similar orders, he set out to examine and determine once and for all the question of the supposed great southern continent. His vessel, the *Resolution*, accompanied by the *Adventure*, commanded by T. Furneaux, crossed the antarctic circle on Jan. 17 of the following year. This voyage, during which he thrice penetrated the antarctic, effectively disposed of the long-cherished illusion. For it became evident that if such a continent existed it was frozen and uninhabitable. In addition, his explorations outlined the main features of the southern portions of the globe much as they remain to-day. Of further scientific interest is the fact that this voyage marked the conquest of scurvy. Cook lost but one man out of 118 on a voyage lasting 1000 days. For this service to hygiene, the Royal Society awarded him the Copley Medal in 1776.

#### Jan 17, 1839.—Balleny Islands

John Balleny, in the schooner *Eliza Scott*, left Campbell Island, south of New Zealand, to search for new land. He reached the antarctic circle in 178° E. on Jan. 29, but later, meeting heavy ice, turned westwards and discovered the group of rocky islands which bears his name. The islands were mapped and geological specimens collected. Balleny was sent out by the firm of Enderby Brothers, a London ship-owning firm trading in seal oil. This firm showed a keen interest in geographical discovery, and one of the brothers was an original fellow of the Royal Geographical Society. They had previously, in 1830, dispatched John Biscoe on a two years' voyage combining sealing and exploration. Biscoe sailed through nearly fifty degrees of longitude south of the antarctic circle and discovered the coast of Enderby Land. He did not know of Bellingshausen's discoveries, but entered that sea and discovered Biscoe Islands and the coast of Graham Land.

#### Jan 18, 1912.—The South Pole

Capt. R. F. Scott found the tent with the record that Roald Amundsen and four other Norwegians had reached the south pole on Dec. 16, 1911. Scott had reached the pole on the night of Jan. 17, but had realised from the tracks that his party had been forestalled. Scott and his companions, Wilson, Evans, Oates, and Bowers, set out on their tragic return journey. Evans fell ill and died, and the time involved in caring for their sick companion considerably delayed the party. A strong surface wind wiped out the track they were trying to follow, weather conditions were persistently adverse, the oil in the tins at the depots was insufficient, weather conditions having resulted in the perishing of the leather washers with consequent evaporation. Yet in spite of weariness and hunger, the party continued to the last to carry the geological specimens collected on the Beardmore glacier. The fossils in the specimens threw much light on the age and past history of this part of the antarctic continent, the gain to science was, however, obtained at the cost of heavy

sacrifice Oates fell ill, and Scott noted in his diary that in spite of the extra burden which this involved, Wilson and Bower remained "determinedly cheerful" Oates not only made no complaint, but also, when he realised that the burden of helping him meant death to his comrades, walked deliberately into the blizzard The weather continued adverse, and finally a prolonged blizzard held them prisoners when but eleven miles from their next depot Their bodies were found, with Scott's diary and the geological specimens, by a party led by Atkinson in the following season Scott's previous journey to the antarctic in 1902-4 had resulted in new topographical data about the southern continent and its fringing islands and new information about Ross Sea Moreover, the sledge journeys carried out by Scott, Shackleton, and Wilson had for the first time thrown light on the interior of the antarctic land The name of Scott is thus associated not only with the first attainment of the south pole by a British party, and with much sacrifice and heroism in the face of disappointment and disaster, but also with valuable contributions to scientific knowledge His successful rival, Amundsen, later met his death in going to the rescue of a fellow-explorer in the arctic

#### Jan 22, 1821 —The Russians in the Antarctic.

Admiral Bellingshausen sighted Peter I Island, the first land discovered within the antarctic circle The Emperor Alexander I of Russia had decided to embark on a scheme of polar exploration in 1819, and later sent out two expeditions, one to the arctic and one to the antarctic regions Bellingshausen was in charge of the latter and sailed from Kronstadt in July 1819 In January 1820 he discovered three small islands north of the Sandwich group, and later penetrated into the antarctic, following the edge of the icepack for nearly forty-five degrees in latitudes from 63° to 60° S His two vessels later put into Sydney harbour for repairs, and spent some time exploring the South Pacific, discovering seventeen new islands On Dec 7, 1820, they crossed 60° S, and remained south of it for two months and three days, during which time Peter I Island and Alexander Island were discovered Bellingshausen's voyage gained greatly in importance because the Russian explorer made every effort to supplement rather than to repeat Cook's voyage He thus demonstrated the existence of a continuous open sea south of lat 60° S

#### Jan 23, 1895 —First Landing on the Antarctic Continent

Capt Kristensen and C E Borchgrevink made the first landing on the southern continent The voyage was made in a whaling vessel rechristened the *Antarctic* and fitted out by the enterprise of Commander Foyen, a Norwegian whaling merchant, then eighty-four years of age The *Antarctic* started on her voyage in September 1893, and spent some time sealing at Kerguelen In September 1894 the vessel left Melbourne, and on Jan 16, 1895, sighted Cape Adare for the first time since Ross's voyage in 1839-43 On Jan 18, 1895, Borchgrevink discovered a lichen growing on the rocks of Possession Island, the first evidence of plant life obtained within the antarctic circle The same lichen was found when the party landed on Cape Adare on Jan 23. The voyage confirmed Ross's discovery of an open sea south of the pack ice as a permanent phenomenon at this season

## Societies and Academies.

### DUBLIN

Royal Dublin Society, Nov 24 —E J Sheehy The effect of an insufficient supply of vitamin D on the growth of the skeletons and internal organs of chickens Chickens which had been exposed to sunlight for ten days after hatching were thereafter kept indoors for thirteen weeks Half received a diet totally deficient in vitamin D, the other half receiving in addition one per cent of cod-liver oil daily The second batch developed normally, but the first, even in those cases where the usual symptoms of rickets were absent, failed to develop even on subsequent exposure to sunlight Their skeletons were stunted and deformed, the breast bones being crooked —A D Delap, A Farrington, R Lloyd Praeger, and L Bouvier Smyth Report on the recent bog-flow at Glencullen, Co Mayo The chief points of interest about this bog-flow are (1) the fact that it occurred after a spell of dry weather, (2) the fact that a comparatively small area moved out of a very large area apparently similarly situated The bog slid from a site where the slope was about 3° into the valley of a stream and thence for several miles down the valley, the gradient of which is about 2°, at a considerable speed It is suggested that the bog was held in position by the vegetation on the surface and that this shrank and split owing to the drought The underlying layer was probably kept in a semi-liquid condition by the drainage from a small tarn on the crest of the hill just above the slide The total volume of the slide was about 400,000 cubic yards —H H Jeffcott The performance of a reservoir subjected to flood Simple graphical and tabular methods are given for finding the rise of the water above the sill of the spillway at any time owing to any assumed combination of rainfall and local circumstances This enables a spillway to be designed which will ensure the safety of the reservoir without an undue sacrifice of capacity —J Lyons and W Finlay The influence of heating and agitating milk before separation on the fat loss in skim milk Experiments carried out under the conditions prevailing in a working creamery show that the increased yield of fat caused by heating the milk before separation rises as the season advances Agitation always tends to reduce the fat separation, apparently by breaking up the clusters of fat globules It is doubtful whether in creameries of moderate size the amount of butter fat obtained by initial heating pays for the cost of the heating

### CRACOW

Polish Academy of Science and Letters, June 12 —St Mrozowski The hyperfine structure of the resonance line of mercury (2) This study, with experiments on the Zeeman effect, suggests that the components of the line 2537 Å are due to various isotopes of mercury —S Szczeniowski and L Infeld The effect produced by a cloud of electrons on the structure of the de Broglie wave In certain exceptional cases, the combined influence of the cloud of electrons and the crystal may result in an effect analogous with abnormal dispersion —Mile A Dorabalska Microcalorimetric measurements of the period of polonium The period of polonium determined by this method has been found to be 137.6 days  $\pm 0.4$  per cent —M Hlasko The differences between the conductivity coefficients of strong electrolytes in the same solvents —M Hlasko and W Klimowski The conductivity of certain mineral acids and the mobility of the hydrogen ion The mobility of the hydrogen ion, calculated from the limit of conductivity ( $\lambda_\infty$ ) of the acids HCl, HBr, HI, HNO<sub>3</sub>, and HClO<sub>4</sub> are (at 25°C) 355.0, 355.2, 355.1, 355.1, 355.1 —K Dziwoni-

ki, W Kahl, and Z Olszewski Study of compounds derived from naphthalic acid The synthesis of 3-4-dihydroxynaphthalic acid —E Mnich The phosphorus compounds of plants (6) The solubility of the phosphorus compounds of bean flour and the faculty of chytine of combining with the protein substances contained in this flour —Tymrakiewicz The stratigraphy of the peat bog situated near Dublany, Olesko, and Opaki The method of pollen analysis has been applied to these three peat bogs in the Haut Bug basin —J Jarocki and A Demianowicz The presence of a ponto-caspian amphipod, *Chaetogammarus tenellus*, in the waters of the Vistula —L Ejsmont The density of *Proshystera rossittensis* and *Tanarsia fedtschenkoi*, with some remarks on trematodes with nited cæca —J Hirschler Observations concerning the reciprocal influence of the larvæ of insects —Z Brodziński The development of the blood-vessels in the pectoral fin of fish belonging to the genus *Salmo* —Rogoziński Experimental rickets (3) The influence of ammonium chloride on the mineral metabolism of the rachitic rat No favourable effect is reduced by the addition of ammonium chloride to the Steenbock and Black diet

July 6 —L Lichtenstein Contribution to the study of partial differential equations of the elliptic type —Blaton The quantisation of atoms by a light wave —K Koziel The exactitude of the proposition of Laplace and Oriani relating to astronomical reaction —T Olczak Measurements of the acceleration of gravity in Poland in the period 1926–30 —Irene W Zablocka The fossil fungi of the Tertiary epoch in the rock salt mines at Wieliczka —Mme W Zablocka *Boletus parasiticus* and *Pisolithus arvensis* —A Demianowicz The terrestrial isopods of Bessarabia —Mile M Gasowska The cestodes of the birds in the neighbourhood of Kiev (Ukraine) —J Muszkowski Studies on the evolutive cycle and the structure of the maritime cestodes The larvæ of *Procotyle urna* —Mme B Konopacka The behaviour of the fat in the development of the embryo of the owl —St Smreczyński Embryological researches on the development of the head of *Salpica obscura*

## GENEVA

Society of Physics and Natural History, Nov 18 —Rossier The statistical distribution of the stars as a function of the type of spectrum (2) The statistical discussion of the complete collection of spectrum photographs of the Observatory of Geneva has led to a distribution of the stars practically identical with that which had been obtained from a selection of the series of plates —P Rossier The absolute colour index and stellar statistics. Application to the statistics of the Geneva Observatory The stellar statistics based on visual brightness show a proportion of less hot stars than that which would have been obtained if the eye had possessed the same sensibility for all wave-lengths For statistics of the hot stars the use of photographs seems to be indicated —G Tiercy A remark on the problem of comet orbits The author presents a note on the first equation of the problem (the equation of the trajectory), when the condition of visibility of the comet is taken into account This condition requires, as is known, that the perihelion distance should be below a certain limit

## ROME

Royal National Academy of the Lincei, June 21 —Vitali A result of F Hausdorff and the compressibility of matter —G A Crocco Aerodynamic bodies of negative resistance —L Labocchetta A new class of circular functions —T Viola Further work on the

dextro derivative of a function continuous towards the right and derivable towards the right —B Hostinský The integration of linear functional transformations. —G Krall Adiabatic transformations in systems vibrating within stable equilibrium configurations —E Segrè New Raman bands of water A new Raman band for water with its maximum at about  $140\text{ cm}^{-1}$  from the primary band is described This band is moderately intense on the low frequency side, but the anti-Stokes band is scarcely perceptible Its origin is attributed to oscillations in the polymerides of  $\text{H}_2\text{O}$ , the low frequency of oscillation being explainable by the appreciable mass of the oscillating parts and the tenuity of the linking This view is supported by photographs taken at temperatures ranging from  $4^\circ$  to  $97^\circ$  —N Apolloni Fauna of the bottom of the lagoon of Orbetello —C Cappelletti Resistance of the stolophyll of *Tulipa silvestris* L to the penetration of mycelia The inability of mycelia to penetrate this organ is to be attributed to the peculiar epidermic structure of the stolophyll, this excluding all infection, whether by micorrhiza or other more or less saprophytic mycelia of the microflora of the soil Owing to such protection, the plant assures to the bud a condition of absolute sterility, so that the symbiotic root life is to be regarded as a phenomenon subsequent to the development of new roots, and is not connected with any infection contracted by the mother plant

## Forthcoming Events.

## Societies

## MONDAY, JANUARY 18

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith Malformations of the Human Body considered from a New Point of View (Hunterian Lecture)  
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —Presidential Address and Presentation of Prizes  
ROYAL SOCIETY OF ARTS, at 8 —Capt O A Barrand and G A Green Life-saving Appliances on Merchant Ships (Thomas Gray Lectures) (1)

## TUESDAY, JANUARY 19

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Prof C A Edwards The Progress of Research relating to Physical Metallurgy (1)  
INSTITUTE OF BREWING (Scottish Section) (Annual General Meeting) (at Caledonian Hotel, Edinburgh)

## WEDNESDAY, JANUARY 20

INSTITUTION OF MINING ENGINEERS (at Geological Society), at 11 A.M. —Annual General Meeting  
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith Malformations of the Human Body considered from a New Point of View (Hunterian Lecture)  
ROYAL MICROSCOPICAL SOCIETY (Annual General Meeting) (at B.M.A. House, Tavistock Square), at 5 30 —Prof R R Gates Nuclear Structure (Presidential Address)  
ROYAL METEOROLOGICAL SOCIETY (Annual General Meeting), at 7 40 —Presentation of the Symons Medal to Prof V F K Bjerknes —R G K Lempfert The Presentation of Meteorological Data (Address)

## THURSDAY, JANUARY 21

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Prof H. G. Cannon Feeding and Digestion in Invertebrates (1)  
INSTITUTE OF BREWING (Yorkshire and North-Eastern Section) (Annual General Meeting) (at Queen's Hotel, Leeds)

## FRIDAY, JANUARY 22

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith Malformations of the Human Body

considered from a New Point of View (Hunterian Lecture)  
 SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (jointly with Manchester Section) (at Liverpool University), at 6—Dr A E Dunstan Liquid Fuels, To-day and To-morrow (Jubilee Memorial Lecture)  
 ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Sir Arthur Eddington The Expanding Universe

#### SATURDAY, JANUARY 23

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3—A R Green Some Interesting Practical Problems in Elementary Geometry

#### Public Lectures

#### FRIDAY, JANUARY 15

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5—Prof L Hogben Genetic Principles in Medicine and Social Science  
 UNIVERSITY COLLEGE, at 5—Dr A S Parkes The Physiology of Reproduction (Succeeding Lectures on Jan 15, 22, and 29, and Feb 5, 12, and 19)—G P Wells Comparative Physiology (Succeeding Lectures on Jan 15, 22, 29, Feb 5, 12, 19, 26, and March 4, 11, and 18)—At 5.30—N H Baynes The History of Asia and Eastern Europe  
 IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5.30—Dr T M Finlay The Evolution of Landscape The Instability of the Earth (Swiney Lectures) (5)

#### SATURDAY, JANUARY 16

HORNIMAN MUSEUM (Forest Hill), at 3.30—Miss M A Murray The Ancient Egyptians at Home

#### MONDAY, JANUARY 18

GUY'S HOSPITAL (Physiological Theatre), at 5—Prof J M W Morison The Use of X-Rays in Physiological Investigations (1) The Use of Opaque Substance with special reference to the Investigation of the Gall-bladder and Kidneys  
 UNIVERSITY OF LEEDS, at 5.15—Prof E T Whittaker The Life and Work of Clerk Maxwell  
 IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5.30—Dr T M Finlay The Evolution of Landscape The Instability of the Earth (contd) (Swiney Lectures) (6)  
 ST THOMAS'S HOSPITAL, at 5.30—Prof W J Tulloch Serological Studies on Vaccinia (Succeeding Lectures on Jan 19 and 20)

#### TUESDAY, JANUARY 19

UNIVERSITY COLLEGE, LONDON, at 5—Dr H R Ing Chemotherapy (1) (Succeeding Lectures on Jan 26, Feb 2, 9, 16, and 23)  
 UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.15—Dr R A O'Brien The Preparation, Testing, and Use of Antitoxin  
 GRESHAM COLLEGE (Basinghall Street), at 6—A R Hinks Celestial Spectacles (Succeeding Lectures on Jan 20, 21, and 22)  
 INSTITUTE OF INDUSTRIAL ADMINISTRATION (at Institute of Hygiene), at 6.30—T Keens Some Problems of Industrial Administration and Accounting  
 UNIVERSITY COLLEGE, LONDON, at 8.15—Miss E Jeffries Davis Some Descriptions of London, c 1175–1830 (1) (Succeeding Lectures on Jan 26, Feb 2, 9, and 16)

#### WEDNESDAY, JANUARY 20

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4—Sir William Willcox The Etiology of Rheumatism, with special reference to Infective Causes  
 KING'S COLLEGE, LONDON, at 5.15—Prof J H Rose The Mediterranean in Ancient History The Mediterranean, the Nursery for Navigation (Succeeding Lectures on Jan 27, Feb 3, 10, and 17)  
 SCHOOL OF ORIENTAL STUDIES (jointly with Royal Anthropological Institute), at 5.15—F H Melland Natural Resources of Africa

IMPERIAL COLLEGE OF SCIENCE (Royal College of Science at 5.30—Dr T M Finlay The Evolution of Landscape Land Sculpture (Swiney Lectures) (7)  
 UNIVERSITY COLLEGE, LONDON, at 5.30—J H Helweg Denmark, the Land and the People (1) (Succeeding Lectures on Jan 27 and Feb 3)  
 BELFAST MUSEUM AND ART GALLERY, at 8—H Lamon Story of Milk

#### THURSDAY JANUARY 21

SCIENCE MUSEUM, SOUTH KENSINGTON, at 4.30—I G C Simpson Weather Forecasting  
 UNIVERSITY COLLEGE, LONDON, at 5.30—Dr S Keeling The Philosophy of J Elms McTaggart (Succeeding Lectures on Jan 28 and Feb 4)—H Vowles Whence came the Windmill?  
 SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACE PROGRESS (at Essex Hall, Essex Street, WC 2), at 8—G Bedborough Recent Developments in the Birth Control Movement in America

#### FRIDAY, JANUARY 22

IMPERIAL COLLEGE OF SCIENCE (Royal College of Science at 5.30—Dr T M Finlay The Evolution of Landscape Mountains (Swiney Lectures) (8)  
 UNIVERSITY COLLEGE, LONDON, at 5.30—Prof H A Gbb The Expansion of the Arabs, A.D. 600–750

#### SATURDAY, JANUARY 23

HORNIMAN MUSEUM (Forest Hill), at 3.30—M A Phillip In the Haunts of the Sea-Birds

### Official Publications Received.

#### BRITISH

Indian Journal of Physics, Vol 6, Part 4, and Proceedings of the Indian Association for the Cultivation of Science, Vol 15, Part 4 Conducted by Sir C V Raman Pp 263–366 (Calcutta) 24 rupees, 3s  
 The National Institute of Poultry Husbandry (Harper Adams Agricultural College), Newport, Shropshire A Progress Report of Institutional and Experimental Work in Poultry and Rabbit Husbandry (No 5) Pp 68 Bulletin No 6 Methods of Artificially Lighted Winter Layers (Single Comb White Leghorn Pullets) By I W Rhys a Raymond T Parkhurst Pp 16 (Newport)  
 The Hannah Dury Research Institute its Origin and Work, with Description of the Buildings, Equipment and Farm Stock, 1931 F 50+2 plates (Aachincruive)  
 The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 70, No 420, December Pp 104+xxii (London E and F N Spon, Ltd) 10s 6d  
 The University of Leeds Pp 8+4 plates (Leeds)

#### FORGIGN

Zum Klima der Türkei Ergebnisse dreijähriger Beobachtungen 1911–1918 Herausgegeben von Prof Dr Ludwig Weickmann, unter Mitwirkung von Prof Dr Heinrich Koppe, Prof Dr Harald Korschmeider und Dr Peregrin Zistler Heft 4 Der Anstieg des Toten Meeres 188–1900 und seine Erklärung Von Johannes Enge Pp 42+8 Karte (Leipzig Geophysikalisches Institut der Universität)  
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 Agricultural Experiment Station, Michigan State College of Agriculture and Applied Science Technical Bulletin No 115 The Diagnosis Species of Fusarium by use of Growth Inhibiting Substances in the Culture Medium By G H Coons and M C Strong Pp 78 (E Lansing, Mich)  
 Regenwaarnemingen in Nederlandsch-Indie Een en vijftigste Jaargang 1929 Pp n+133 (Batavia Landsdrukkerij)

#### CATALOGUES

A Catalogue of Periodical Literature, Transactions of Learned Societies Narratives of Important Voyages, etc (No 452) Pp 114 (London Bernard Quaritch, Ltd)  
 Zeiss Surveying Instruments (Geo 123) Pp 24 The New Zeiss "Lodis" Tacheometer for Rectangular Coordinates (Geo 103E) Pp 16 The Zeiss Telemeter for the Measurement of Distances by Readings on Vertical Staff (Geo 106) Pp 4 The Zeiss Self-reducing Tacheometer (Geo 59) Pp 4 The New Zeiss Universal Theodolite III (Geo 94) Pp 8 Zeiss Precise Level I (Geo 104) Pp 4 Economic Aspect of the Optical Measurement of Distances in Surveying and the Zeiss Reducing Tacheometer By R Bosshardt (Geo 78e) Pp 8 (Jena and London Carl Zeiss)





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## India: The Real Problem.

THE course of events in India since the rising of the Round Table Conference in December last may well seem to confirm the opinion of those who held that little practical good was effected in the second session of that body, which lasted throughout the autumn. This view of the result of the conference was perhaps unduly pessimistic. The unexpected adherence of the Princes brought the question of an all-India federation within the range of practical discussion and even though the differences of Hindu, Sikh, and Moslem were not resolved, and the position of the Outcastes remains unsecured, goodwill and mutual understanding were advanced by discussion. This has been admitted by delegates on their return to India. But most significant of all, perhaps, was the final phase in which the Prime Minister seized the opportunity to make the momentous declaration on behalf of the National Government, afterwards embodied in the White Paper, that Great Britain would press forward towards measures of constitutional reform in India even though the Round Table Conference had produced no concrete proposals to meet the difficulties which stand in the way.

However strong may be the body of opinion, whether in Great Britain or in India, which doubts the wisdom of the grant of self-government to the greatest of our dependencies, the day for argument has long gone by. It is for this reason that much of the discussion on the White Paper in the debates in the two Houses of Parliament, admirable as it may have been from the constitutional point of view, seemed to be fatally out of touch with the needs of the situation, when it pressed for delay before endorsing the principles of the Prime Minister's pronouncement. The firm declaration of Great Britain's determination to go forward and the practical measure of the appointment of Committees to explore the ways to a solution of outstanding difficulties conveyed a much-needed message to the peoples of India as a whole.

This message stands in no danger of the misconception of weakness to which eastern peoples are prone in viewing a concession. The firm handling of the situation at the first sign of disorder on the return of Mr Gandhi to India and the action taken against the Indian Congress and kindred associations, as well as against the so-called 'Red-Shirts', opportunely accompanied as they were by a reaffirmation of the Government's intentions in the matter of constitutional reform, served to confirm the impression which it had evidently been the intention

of the Prime Minister to create. Granted a tactful and informed handling of the problems which must come under consideration in the near future, and the position of the Indian Congress should become untenable.

It must be borne in mind, in considering the situation as it stands to-day, that of late years in India a fundamental change has come about. This is due to the growth of what, for lack of a better term, may be called a 'national feeling', so far as such a thing can exist among so many diverse peoples. In dealing with the political problems of India we are no longer confronted, as was once the case, by the political agitator only, or even by one class alone, claiming on racial, social, or intellectual grounds a predominant share in the affairs of the State. The desire for change is spread over the whole area, almost without distinction of race, creed, or tongue. In parts, the rural population, which forms the largely preponderant majority of the peoples of India, crushed by economic conditions, often unable to earn even a bare subsistence owing to the fall in prices and the low value of silver, and crippled by debt and arrears of rent, would welcome alleviation of its troubles from almost any source. It has been persuaded that relief will come with political reform. The danger is that its only hope should be in the revolutionary nostrums of the political agitator and the suggested agrarian measures which the Indian Congress, aiming at usurping the functions of the Government, has formulated. This is the India, blindly seeking relief, to which Great Britain speaks. It is the India from which she has received loyal support in the past, and will once again if the present crisis brings forth anything like an adequate solution of social and economic difficulties. But it must be said that no solution will prove adequate which is not firmly based on intensive and scientific study of the racial and sociological factors which enter into the situation.

The difficulties with which we are confronted in India are to a great extent of our own making. It is true that they are not peculiar to India. They arise wherever an attempt is made to graft European political ideas and machinery on to the social concepts of the Oriental, as, for example, in China. The strength of our rule in India lay in the loyalty of the population, and particularly of the rural population, to the British *raj* as personified in the King-Emperor, just as the personal link with the emperor was the binding force in the Chinese empire. It is often stated—usually with some air of authority—that Orientals are best ruled by an

alien race. The saying has some justification, but it requires qualification. Where it has held good, acquiescence in an alien rule and loyalty to the ruler have been proportionate to the extent to which this rule has accorded with the ideas of the subject race—in other words, so long as the ruler has left their institutions and beliefs untouched. Notwithstanding many mistakes, this has been the basis of what, on the whole, has been our successful rule in India. But we have allowed loyalties to be diverted by political agitation so that now the people no longer accept an alien rule unquestioned even in the native States. In Kashmir, for example, the Moslem population voices its discontent against the Hindu princes whose rule it has endured for generations.

The twentieth century reaps what the nineteenth century has sown. Although the study of the languages, literature, and history of India made great strides in the nineteenth century, relatively little attention was paid to the living institutions of the people, outside those spheres in which they came into contact—it might almost be said into conflict—with the laws and regulations laid down by a European administration fundamentally from a western point of view and only gradually and slowly modified to any degree of conformity with the outlook of the Oriental mind. Such knowledge of custom and belief as was acquired by officials in the course of their duties—of necessity, they found, as an essential condition of dealing faithfully with the people under their jurisdiction—was uncoded, often lost, on their retirement, because unrecorded. The theories of Max Müller and Sir Henry Maine's studies of Indian institutions gave an impetus to ethnographical observation among the people and the record of their customs and beliefs which bore fruit in the studies of Crooke, Risley, and other workers in the latter part of the nineteenth century and the early years of the twentieth. But it was long before it was realised that these studies had any bearing upon the problems of administration, except by a few such as the late Sir Richard Temple, who had attained that knowledge empirically. It is doubtful how far even to-day it is realised how vital is the bearing of anthropological studies, not merely on the ephemeral difficulties of administrative routine, but also in the solution of the graver problems of the future of the rank and file of the Indian peoples which will arise under the altered conditions of India when, in greater or less degree, it is responsible for its own government.

Even had no other forces been at work, with

this failure to appreciate the significance of native institutions in view, it is not surprising that the development of the Indian has proceeded entirely on western lines, and that the only road open to him to progress in education, in the arts or sciences, in industry or commerce, and in political life has been directed solely towards European ideals. In consequence, advancement has been confined, broadly speaking, to the higher strata of the people, and that, too, of the urban classes. On the other hand, for the rural classes, who constitute the vast majority of the population, very little has been done by British rule to help them in any real progress towards a higher level of culture and an improved standard of life, which, it has been assumed, next to the preservation of law and order, it is the aim of good government of a people of backward culture to secure.

The more closely anthropologists study the conditions which arise when European ideas and culture come into contact with those of less highly civilised peoples, the more clearly it is appreciated that the harmful effect of the impact results from the break-up of the less advanced institutions and the emancipation of the peoples from their traditional controls. Native institutions need strengthening rather than weakening, while progress can most safely be promoted by a gradual modification of these institutions in directions which are in harmony with the temperament and genius of the people. The circumstances of India, combined with British policy, which, mainly, has been one of non-interference, on the whole have served to protect the rural population from this break-up of tradition, but there are signs of change. It is this rather than the agitation for constitutional reform that in the long run will call for every resource of skilful statesmanship.

It is dangerous to generalise in dealing with a country of so many races, creeds, and languages and so many variations in degree of culture as lie within the bounds of India. One generalisation may be made, however, with moderate assurance, and that is that the one stable political factor is the village-community. Whatever may be the type and the organisation of the village-community—and the variation is indeed wide—the social consciousness of its members finds expression, not as individuals, but as parts of a unitary organisation in which each individual has a recognised grading and a voice carrying more or less weight in the settlement of communal affairs. To a communistic mentality at home in this environment, the franchise, the supreme, and, indeed, the only expression

of political individuality open to modern democracy, offers little that is comprehensible. Unless self-government in India is to become a pretence and an oligarchy in the hands of a section representing at most perhaps a tenth of the population, the problem of India lies in the development of the village-community and the mentality of its members on lines which will lead eventually to real self-government through the representation which at present lies outside their experience or even comprehension. This is a problem to which either the Committee on the Franchise or the Central Advisory Committee now set up might well direct their attention. But it may not be out of place to suggest that the skilled advice of those who have studied closely village-community organisation from the anthropological point of view should be sought. Modification of such institutions without full knowledge of their content or meaning in the life of the people has been shown by experience too often to bring disaster.

In Burma, by the reservation of the Shan States as a backward area, the reformed Government is to be relieved of the problem of its less advanced compatriots. In India it looks as if we shall pass over this problem to the governments which will succeed us. In any event, whether it should be found possible or not to develop the political sense of the people through their existing institutions, the portents are that an even greater understanding of them, such as comes from trained study on anthropological lines, will be required of the administrators of the future. This holds good in no less degree because those from whom such understanding will be demanded in days to come will be natives of India rather than Europeans. This is one of the reasons which weighs with those who think that the trend in the past has been towards the too thorough Europeanisation of the educated native of India. But to suggest that Indian education needs a new orientation towards the art, culture, history, and economics, as well as the natural history and geography of its own country and peoples, opens up a question upon which we must not dwell at this moment. For the present purpose it must suffice to point out that such a change in orientation is an inevitable and necessary condition of success in the self-government on which India is bent. Experience confirms the view of common sense that the high-class educated native of India is no more capable than the European of comprehending without close study India's infinite variety of language, race, and culture.

### Back to the Land.

*Rediscovering England* By Charlotte A Simpson  
Pp 360 (London Ernest Benn, Ltd, 1931)  
21s net

BACK we must and without delay This book has an arresting value as a meritorious and attractive attempt to develop and encourage an interest in the countryside, now fast being buried in bungalows, tarmac, petrol pumps and pill signs, its matchless beauty by-passed out of existence everywhere, even in far Glencoe, the life-blood of its once majestic trees drained away to river and sea (seen in Greenwich Park and infested elm areas), incidentally, the phosphates are sent awash. A couple of thousand years hence, perhaps, England will be rediscovered and disinterred, like Herculaneum, by its curious Mongolian possessors, who will write books, like Flinders Petrie's, in which they discuss the overwhelming evidence they have found of a once glorious civilisation becoming rapidly decadent, owing to the introduction of a debased religion, which had led to the entire neglect of the natural and the worship of brazened gods called machines. This, at the hands of a selfish, commercialised priesthood of engine-makers, working to enslave man and make him unnecessary, burying him in the pit and the town and binding him to rivers of water and of oil, instead of inspiring him to fall down upon and worship the soil from which alone he comes and can gain sustenance.

England has not yet even been discovered by the schools nor any proper desire to know it implanted in their pupils. Since cycling came in, boys and girls have learnt to read maps and cleverly use them in rushing about—to no other end. The 'muddled oaf' on cricket or football field knows clay only as dirt. In days gone by I have tested hundreds of them from public schools and found scarce one who had learnt more than that you slip upon it.

For in the Market-place, one Dusk of Day,  
I watch'd the Potter thumping his wet clay,  
And with its all obliterated Tongue  
It murmur'd—"Gently, Brother, gently, pray!"

We thump it with plough and upon potter's wheel without thought. Now "its all obliterated Tongue" must be tended and healed, made vocal to us all. That we should only take interest in it when flung into ever-receding space in nebula and star is preposterous. As geologists cannot get us gold enough, they might well take up such lesser things and seek to make their value more plain.

Who cares to know the make-up of 'Our Realm of Albion'—how many can give an intelligent interpretation of the phrase and locate Albion-stuff?

In the school of to-morrow, when education is thought of as a preparation for life, not for an examination, maybe an arrangement will be made with the local Office of Works for the supply, at arranged intervals, of a few cartloads of road making or building material, together with gravel, sand and clay. These will be dumped in the playground and thoroughly studied. The various hard rocks will be supplied in big pieces needing to be broken to gauge. Children will have an opportunity to learn what stone-breaking involves and what the feel of stones is. Clay, loam and sand will be dug over and handled. Frequent visits will be paid to local exposures. Bricks will be made. Limestone will be burnt to lime, this slaked, made into mortar and a wall built. Various rocks will also be studied in the school workshop, not in the superficial way that is now customary but measured and weighed so far as is necessary to establish their individual characters. Sections will be cut and examined under the microscope, stones will be polished and worn. The classroom will be used mainly for discussions and in writing considered accounts of the work, in amplification of notes taken while it is in progress. In this way, English will be taught by the Squeers method after all the only sane method. Unless instruction of this order be given in the near future, no God will be found to save us.

We have less to consider what is in Miss Simpson's book than the vision it calls up of the vasty deep of ignorance before us, of what might be and what should be in the now empty pates of those who scorch—or even hike—through our highways and byways. Hiking is sure good for the muscles and lungs—what of the soul? We wonder what the average talk of the hiker is—the proportion of 'eyes' to 'no eyes'.

The authoress—it is a mistake to speak of a woman writer as 'author', the words are not synonymous—is lecturer in geography at Warrington Training College, Liverpool. Her book is welcome evidence that the teaching of the subject is at last coming into enlightened hands and tinged with geology. Although geology is the one and only possible foundation of a true geography, the subject is scarcely if ever mentioned in most schools. Where taught, it is taught apart and mostly at the desk. Years ago, visiting a noted school, which

professed to teach geology and gave the subject its room, injudiciously inquiring what sections in the district—one rich in outstanding examples—had been visited, I discovered that it was only a four-wall subject. I have never ‘acquired merit’ in my own estimation so much as when I was able to couple geology with geography upon the first plans for the recently erected extension of the science buildings at Christ’s Hospital School. The two names now appear together upon several classroom doors. Has such happening ever been before? Still, I doubt if I shall live to see the children swarming about my heaps o’ stones in the yard and the teacher with the *nous* and enthusiasm to conduct the worship, I say children, because such work must be begun in the preparatory school and ever afterwards continued.

A true geography is now coming upon us, through the enlightened enterprise of the railway companies and also through the publication of often most admirable large scale reproductions of photographs in the press, especially the *Times*, which is setting a great example. One of the first, if not the first, of the magnificent half-page pictures published in that journal, was that of the southern end of the Jaws of Borrowdale, which I had sent to them at the time when we were trying to prevent the desecration of the valley by the soulless engineer on behalf of the road-hog, unfortunately, without effect. The memorial ‘mutton-back’ we desired to save from further injury is figured by Miss Simpson, as it was before the snout was wickedly blasted away.

The pictures we now get in the press are some consolation. Yet they are apt to be misleading, though good in form, owing to the vagaries of the modern over-corrected photographic plate, which now has a nasty trick of rendering yellow and red in white. This distortion was specially noticeable in the striking picture of the Sidmouth coast published in the *Times* of Oct 24. Perfect in outline and as a panorama, the entire stretch of coast appeared white as if it were chalk. Actually, only the far-distant corner, Bere Head, is Chalk rock, the rest is a deep red, capped by yellow Greensand and a final, scarcely perceptible thin layer of chalk east of Sidmouth. The Southern Railway displays a magnificent poster of South Devon, giving the true appearance of the red rocks, in another, the junction of the chalk with the New Red beds is strikingly shown.

The photographer of coast scenery to-day needs to have the geologist’s eye and must choose light, plate and screen with considered care. An in-

valuable series of posters is now being produced by the railway artists, showing that they are most accurate observers not only of form but also of geological character as shown by colour. At the recent Faraday Exhibition, at the Albert Hall, as one illustration of the use now being made of colours derived from Faraday’s benzene as printing inks, at ‘The Sign of the Hexagon’, a particularly fine series of posters was arranged along 36 feet of the screen at the back of the stand, showing how geology may now be studied *from the railway platform* colour chemistry, too, if you will.

No school should be without these posters, it would be to the advantage of the railways to put themselves in communication with the schools, so as to provide these regularly with appropriate issues. The Empire Marketing Board might join in the game. Foreign posters might be included though often flamboyant and misleading in colour, these are faithful in form and very attractive. If children saw posters at school, the question ‘where to go in the holidays’ might often be answered with intelligence—not so frequently from the Lido point of view, perhaps, though some companies seem to favour the display of muscular femininity rather than of scenic beauty.

Consider the effect of using the railway posters systematically. We have quantities of sand everywhere upon our island shores, upon which spade and pail are most deftly used by multitudinous young urchins during the holidays. The children are patently full of an inquisitive intelligence, yet when they go to school they take no further interest in the material which we are told forms at least 60 per cent of the crust of our earth. I have suggested above a way of continuing the spade drill, the pail should also not be forgotten. Picture the joy many youngsters would have in helping to boil down pailfuls of sea water and extracting the salts systematically. The discovery that there are so many different things in sea water is itself a revelation. Suppose the study of sand and sea were thus quietly continued at school, young people might go to the seaside not only with minds but with minds really prepared to find “sermons in stones”—an art that has made little popular progress since melancholy Jacques advocated its practice notwithstanding the money lavished upon our schools and the attention nominally given to Shakespeare.

The mental vacuity of the average seashider is delightfully pictured in “A Fortnight in September” by R. C. Sherriff, though reflection falls upon the literary interpreter in putting no high lights into

his picture Surely there are thrills to be got out of the rocks Are the word purveyors, the Aldous Huxleys, ever to wander in realms of merely euphonious expression? Will they not learn something of Nature outside man and lead him to see that he may sometimes adventure with profit away from himself Have their forefathers lived to so little purpose that they have no care for real culture? The broad culture that I heard Huxley advocate, full fifty years ago at Birmingham, is no more come upon us to-day than it was then—the literary mind seems to be ascientific, in the Huxley sense it lives only in the hlt of words so, the sooner we decide to depose it from our schools the better down to Nature, back to the land, we must in some way go We must learn to lime our souls as well as our soils "Lime!" I hear the young Huxley say, "What is lime?"—as if it were a carminative! He inherits no interest in it

Miss Simpson would make geo-topography—not geology—the key-note to the development of the countryside Unfortunately, she flings only scraps of geology at her readers Most will have no fundamental earth-knowledge It is this fundamental training that is so necessary and so lacking to-day Rocks must have been hammered off and handled sections visited and photographed the nature and worth of fossils and of stratigraphical relations, the character of soil, realised There must be clear elementary understanding of the chemical nature of sedimentary and igneous rocks It is pleasant enough to speculate why this village is on the hilltop, that in the valley below this, however, leads nowhere

Our business to-day is to understand the ground upon which we live, sufficiently to use it to the general good, we need to extend our view to the Empire, if we are to avoid making endless mistakes Some day Australia must awaken to the importance of the study and see how much of the land is not habitable

Far too much is attempted The book is one to be read with interest and profit but not as a guide to methodical study in fact, as in all our attempts at didactic, scientific writing, the intellectual process is in no way made clear that we aim at developing by observational and experimental study The illustrations are exceptionally good and sometimes really beautiful—that of the Stroud valley from Burleigh, for example It is a pity the authoress does not give us more of her own work—the example at p 151, 'A Cotswold Barn', is definitely a work of art

The book is also full of literary charm—though this side is a little overdone Still, to have brought "Defoe's Tour through Great Britain" to the fore is no slight service Strange to say, Charles Kingsley's "Lectures on Town Geology" nowhere finds mention it is the one book into which method enters, the book of scientific essays in which it appears should be studied by every teacher of geography The use made of the pictures is sometimes far from what it might be, if not misleading On p 189, for example, a photograph is reproduced of Grange, Cumberland, showing the bridge over the Derwent at the foot of Borrowdale it is one of the best of its kind I have ever seen The reference (to glaciated country) is as follows —

"The most casual visitor and lover of scenery will notice the boulders of different shapes and sizes scattered over the hillsides, obviously brought from a distance and dropped there by some means which no longer exists Also many rocks partly embedded in grass or bracken have their surfaces rounded and smoothed as if by something of the nature of sandpaper passing over them One of these is shown in Fig 32, between the village and the bridge"

'Grange is conspicuously free from scattered boulders The rock referred to, just behind the bridge, at the far end adjoining the cottage, is noted among geologists It is part of the general rock mass, not an embedded rock glaciated over the whole of its surface, down to its base below water in the shallow stream, it is clear evidence that the rocky river bed has remained unworn and unaltered in level since the Ice Age, whenever that may have been Unique in its way, it should be scheduled as a national monument, so that it may be protected against any and all future disturbance.

In adding, in a pocket, a copy of the Geological Survey map, beyond question the most wonderful map in existence, Miss Simpson has done notable service

Whatever the shortcomings, the book is to be commended as a whole-hearted attempt to further the study of a neglected and undeveloped subject In making an appeal to headmasters, thirty years ago, I quoted words used by Matthew Arnold —

"The want of the idea of Science, of systematic knowledge is the capital want of English education and of English life"

He would say this to-day, if with us We have still to follow the advice he gave in 1886 in saying—"the ideal of a general liberal training is to carry us to a knowledge of ourselves and the world"

This is geography *in excelsis*—in its every mood and tense, a subject as yet unrecognised in the



schools Our architects to-day have so little æsthetic feeling, they are so rigid in their outlook, that in the buildings they erect, talk is becoming a mere clatter of noise modern building involves rejection of the brick and of the human hand and is soulless in its lack of softness, even the mortar is a hard synthetic cement In like manner, the 'science' of the schools is mere clatter of noise Having done so much to paint our globe red, it is time that we took up the serious study of at least the reddened areas if we do not, we may easily lose both them and ourselves

HENRY E ARMSTRONG

### The Constitution of the Human Body.

*The Physical Basis of Personality* By Prof Charles R Stockard Pp 320 (London George Allen and Unwin, Ltd, 1931) 12s 6d net

ALTHOUGH Dr Charles Stockard, professor of human anatomy in Cornell University, has given the title "The Physical Basis of Personality" to the book under review, it is in reality an important contribution to our knowledge of the physiological and developmental processes concerned in the shaping of the human body Under the action of these processes human types are moulded, and new races and species are ultimately produced The author explores the machinery of evolution from a new angle His primary purpose is to explain, not the resemblances which link one man to another, but the differences which distinguish every individual born into the world from all other births—past, present, and future It is an explanation of the 'uniqueness' of every birth and of the manner by which every human being comes by his or her 'individuality', 'personality', or 'constitution' that is Prof Stockard's quest

Prof Stockard's search carries him first to the 'physical basis of heredity'—the chromosomes of the fertilised egg He reads into the human egg what has been learned from the egg of the fruit fly—*Drosophila* Personality, he holds, is determined as soon as the chromosomal constituents of the male and female elements have become assorted in the fertilised ovum He then turns to experimental embryology to discover how the qualities inherent in the chromosomes of the fertilised egg become manifest or are 'expressed' during the earlier stages of development He comes to the conclusion that although the basis of personality is already present in the egg, yet the expression of all

the potentialities depends on 'environment', particularly on the 'internal environment', which in the case of the embryo is the fluid by which its cells are bathed and nourished Prof Spemann's researches have thrown a flood of light on the nature of the internal environment The tissue fluids of the embryo are charged with substances which act as 'organisers' From fertilisation to death in old age the internal environment is ever changing, hence 'personality' is never fixed, it alters in every decade from childhood to adolescence and from adolescence to serene old age Prof Stockard concludes that the personality of every man and woman is determined by the interplay between their chromosomal potentialities and the environment which these potentialities meet with when seeking for expression External environment is effective only when it can alter the internal environment and constitution of the individual

The best parts of this book are based on investigations carried out by the author himself Prof Stockard was bred in the orthodox school of reconstructional embryology and continued in the straight anatomical path until 1907, when he had his first lapse into experimental embryology By hatching eggs of the minnow in sea-water, to which he had added a certain percentage of a magnesium salt, he produced one-eyed and other monstrous forms He was thus made to realise the importance of internal environment After a brief interlude spent on the study of regenerating tissues, he again resumed his inquiries into the influence of internal environment Alcohol was the agent he selected for experimental study He subjected guinea-pigs, generation after generation, to an over-dosage of alcohol, to ascertain whether or not their germ-plasm was thus damaged Although in the earlier generations there was a high mortality of the young within the uterus, the ultimate result of the experiment was the production of guinea-pigs as sound as the original breed He then resumed his studies in experimental embryology, amplifying and exemplifying Wilhelm Roux's conception of the 'struggle for expression' which goes on between the developing parts of an embryo

Then, in 1921, Prof Stockard struck into another field of inquiry, and obtained results which form a large part of his present book He became interested in the tissue fluids—the 'internal environment'—not of the embryo and foetus, but of the growing child and matured adult. Starling's demonstration that growth-controlling substances—hormones—circulate in the tissue fluids, and the belief, acted on by medical men, that growth

disorders of the human body are brought about by a break-down in the normal interplay of the glands of internal secretion, led Prof Stockard to seek for means of putting these beliefs to the test of experiment. The breeds of domesticated dogs seemed to offer ideal opportunities for his purpose. Dog fanciers, quite unconsciously, have exploited the growth-controlling or hormonal systems of the body to produce the various known breeds. Prof Stockard regards the Irish wolfhound as the plain (non-acromegalic) form of canine giant, the bloodhound and St Bernard show the features met with in human acromegalic giants, the mastiff has the qualities of simple acromegaly, toy breeds are canine counterparts of human dwarf-midgets. The British bull-dog, the dachshund and the griffin reproduce the various forms of achondroplasia met with in all races of mankind. To exploit this new field Prof Stockard found it necessary to add to his anatomical department a farm for experimental morphology.

It is not necessary to review the results which Prof Stockard has obtained at his farm. Two matters, however, are too important to be passed over. He has found that there are exceptions to Dollo's law of the irreversibility of evolution. He has succeeded in bringing back, to the feet of guinea-pigs and dogs, digits which were supposed to have disappeared for good. The 'genes' responsible for the missing digits must still be latent in the germinal chromosomes. He finds, further, that growth control involves two factors—a local factor inherent in the organ or part, and a circulating factor, a hormone. Further, however much the internal environment may be changed, the inherited influences, conveyed through the germinal chromosomes, are dominant in determining the form of growth. In this connexion, however, it must be remembered that the 'organisers' of the embryonic body and the hormones of the growing child are also the results of influences which are transmitted through the chromosomes of the fertilised ovum.

There is one important contribution added to our knowledge of evolution since Prof Stockard wrote this book, which will certainly lead him to modify one of his statements. He accepts the conclusion reached by Sir Francis Galton namely, that "all families and stocks have a strong tendency to return to the mean of human ability, mediocrity." If this were really true, it is difficult to conceive how the evolution of a new type or of a new species would ever have taken place. Prof Karl Pearson has proved (*Annals of Eugenics*, 1930, vol 4, p 1)

that in an isolated community, of any kind of living things, the tendency is not to return to mediocrity, but for the qualities with which the community was originally endowed to become ever more intensified. Prof Stockard's own experiments seem to support the law of Pearson rather than that of Galton.

Prof Stockard is a human anatomist of a new kind. He seeks to unravel the problems of morphology by an appeal, not to the dead, but to the living body. His "Physical Basis of Personality" must be recognised as one of the most important contributions which has been made in recent years to our knowledge of the biological processes concerned in the evolution of humanity.

A KEITH

### The Metallic State.

*The Metallic State Electrical Properties and Theories* By Dr W Hume-Rothery Pp xx + 372 (Oxford Clarendon Press, London Oxford University Press, 1931) 25s net

IT becomes increasingly difficult to-day to work contentedly at any one corner of knowledge, unrecking of the repercussions between the different branches of science, moreover there exist borderline regions, the successful cultivation of which demands an intimate acquaintance with the facts and theories of two or three branches of science. At the same time it is not easy to take a catholic view—the enormous mass of accumulated facts, increasing in a manner which reminds one of the expanding universe, drives us, in despair of ever coping with them, back to the position of the specialist, cultivating our corner, perhaps not so contentedly, as we muse upon the inter-relations which we are perforce ignoring.

Metallurgy, and the relevant parts of physics and chemistry, exhibit very markedly the confusions and difficulties which arise from this lack of collaboration. As Dr Hume-Rothery points out, the practical metallurgist, interested in the properties of metals of commercial importance, has amassed a large amount of information which is not, however, seen against a background of general principles, and in particular has not been correlated with the regularities of the periodic table. The physicist, who has made most precise measurements of the thermal, electrical and elastic properties of metals, has not merely ignored the periodic table, but, "out of touch with scientific metallurgy", has carried out "much experimental work of the highest quality on specimens

which any scientific metallurgist would have condemned as unsuitable."

All the more grateful should we be to him who, possessing the necessary qualities of detailed knowledge and philosophic breadth of view, essays this task of correlation and carries it to a successful conclusion, as Dr Hume-Rothery has certainly done. He is at once encyclopædic and eclectic, encyclopædic, inasmuch as, even where little information is available in the book, he provides us with 'pointers' which serve to show where that information may be gained, eclectic, in that he chooses for detailed description certain parts which presumably are most to his personal taste, as they are obviously written *con amore*. It must be confessed that he has, for the most part, chosen well and wisely.

The book is divided into two sections—the first section dealing with the experimental facts, the second with the various theories that have, from time to time, been propounded to correlate these facts. Detailed discussion of experimental technique very properly finds no place in Dr Hume-Rothery's scheme, none the less, as we have just remarked, he gives ample references for those who wish to study experimental methods. The first section, which occupies rather less than half the book, contains chapters dealing with the electrical conductivities of pure metals, primary metallic solid solutions, secondary solid solutions and inter-metallic compounds. The facts dealing with the effect on resistance of temperature, pressure, and of stress and deformation are very fully and clearly stated, and space is found for a fairly detailed account of galvano- and thermo-magnetic effects. The thermal conductivities of pure metals and of alloys are next discussed, and the effects of temperature, pressure and deformation are described. Chapters on thermo-electric properties, emission phenomena and contact electricity complete this section.

It will be seen that Dr Hume-Rothery has omitted all consideration of the facts connected with specific heats. The omission is deliberate, inasmuch as "these are dealt with in most books on Physical Chemistry." But similar remarks may be made concerning most of the sections with which Dr Hume-Rothery has dealt. After all, it is the angle of outlook that matters, and we trust that, in the next edition of his book, the author will reverse this decision, and will give us a résumé of specific heat results as clear as those dealing with the properties just mentioned.

It is pleasant to note that, in a book which

carries us to the confines of existing knowledge on the subject, Dr Hume-Rothery, with the instinct of a teacher, is not afraid to begin at the beginning. Thus his chapter on thermo-electric properties begins with an admirably simple discussion of the fundamental phenomena, which may be read with profit by the general student. Concerning this discussion, attention may be directed to one point which is commonly overlooked in the elementary thermodynamic treatment of the matter. The thermo-electric electromotive force  $E$  is a property of the whole circuit. If now we attempt to establish the equations of the circuit by assuming that the cold junction is kept at a constant temperature  $T_0$ , and that the hot junction, originally at  $T$ , is raised to  $T + \delta T$ , the differential coefficient  $\delta E / \delta T$  is certainly not a property of the whole circuit. The point is subtle, and neglect of it has given rise to considerable confusion. The whole matter was very fully discussed by Prof A W Porter in his presidential address to Section A at the Glasgow meeting of the British Association.

In the second portion of the volume Dr Hume-Rothery has been faced with a task of more than ordinary difficulty. Here again he has resolved it by beginning at the beginning, a method which, although it involves a certain amount of repetition and of discussion of discarded theories, is more likely to beguile the reader up the steep slopes, "with learning put lightly, like powder in jam", than is the opposed process, not uncommon nowadays, of plunging him "directly into the strange conceptions which are resulting from the new quantum mechanics."

In this section, then, the first chapter deals with Drude's simple free electron-gas theory, the second with the older complex gas electron theories. Chap III gives a brief conspectus of certain 'intermediate' theories, including Thomson's di-pole theory, and the theories of Wien and Gruneisen, of Bridgman and of Hall. Chap IV is concerned with Lindemann's electron-lattice theory, and Chap V with the Sommerfeld theory. The concluding chapter contains, *inter alia*, an admirable section on the periodic classification, and in an appendix is given what is, in effect, a translation of Bloch's paper of 1929, in which the motion of the free conductivity electrons is supposed to be a motion in a periodic field of force of period that of the atomic lattice.

Dr Hume-Rothery has given us a thoughtful and well-ordered survey of a more than ordinarily difficult region. His book may be unreservedly commended.

ALLAN FERGUSON

## Short Reviews.

*Air Ministry Meteorological Office British Rainfall, 1930 the Seventieth Annual Volume of the British Rainfall Organization Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1930 as recorded by over 5000 Observers in Great Britain and Ireland* (M O 335) Issued by the Authority of the Meteorological Committee Pp xix + 292 (London H M Stationery Office, 1931) 15s net

THIS volume contains maps, tables, and descriptive matter in the usual form, together with special articles on the exposure and shielding of rain-gauges at Penrith and Hythe, on measurements of wind velocity at the level of a rain-gauge, on the Jardi rate-of-rainfall recorder, and on cloudbursts on Stanmore in Westmorland.

For the British Isles as a whole, the rainfall of 1930 was 115 per cent of the average, the year being the eighth wet one in succession, though over a small part, including the Thames Valley, it was drier than usual. There are two outstanding events to note. One was the sustained torrential rainstorm on July 20-23, when 11.97 inches was recorded at Castleton, near Whitby, in Yorkshire, resulting in great damage to bridges in the valleys of the Esk and Leven. In regard to this storm, the geographical reader will not be pleased to see the country behind Whitby repeatedly referred to as the Wolds instead of the Moors. The Wolds, terminating in Flamborough Head, are the most northerly extension of the English Chalk system, and are separated by the Vale of Pickering from the very different country formed of the Jurassic rocks to which the North Yorkshire Moors belong.

The other event was the cloudburst in Westmorland on June 18. On this day, when violent thunderstorms were fairly widespread, there broke over Stanmore Forest, at the southern extremity of the Cross Fell range, one of those formidable storms of the 'cloudburst' type which, as records show, are relatively common on the high fells of northern England. Peat was removed from several acres of moorland, leaving deep scars on the hillside the debris causing quantities of fish to be suffocated lower down in the River Eden. Mr F. Hudleston, who describes the occurrence, says that the moors appeared to lie under a sheet of water and that something in the nature of a water-spout, from the sudden collapse of a heavily charged cloud, must have developed over Knipe Moor, where the holes were dug out.

L C W B

*Die tierischen Schädlinge des Ackerbaues* Von Sofie Rostrup und Prof. Dr. Mathias Thomsen. Nach der vierten dänischen Auflage ins Deutsche übertragen und für die deutschen Verhältnisse bearbeitet von Dr. H. Bremer und Dr. R. Langenbuch. Pp xi + 367 (Berlin Paul Parey, 1931) 18 gold marks.

THIS well-produced book, dealing with the animal pests of agricultural crops, forms a thoroughly reliable and up-to-date manual on the subject. It is

a German translation of the fourth Danish edition of the same authors' "Vort Landbrugs Skadedyr" (1928), with certain additions and amplifications in order to adapt it to German needs. The number of illustrations has also been increased. Although specially written for continental readers, this book will be found to include very few pests that are not concerned with some form of crop injury in Britain. It is, therefore, a volume which can be consulted with profit by workers and students in Great Britain. The bulk of the letterpress is, naturally, devoted to destructive insects, and other arthropods, but there are also chapters dealing with Nematoda, Chaetopoda, and Mollusca.

The method adopted is to treat of the individual pests by the orders or groups to which they belong. Each species is briefly but concisely described, its biology is discussed, and standard control measures explained. These accounts are clearly written in a terse style and most of the species dealt with are very well illustrated, with figures portraying the characteristic injuries they inflict. At the end of the book there is a tabular summary of the different pests arranged upon a crop basis. As a kind of appendix there is a short, but useful catalogue of modern literature classified under the names of the pests concerned. All concerned in the production of this volume are to be congratulated upon its general excellence.

A D I

*The Official Year-Book of the Scientific and Learned Societies of Great Britain and Ireland a Record of the Work done in Science, Literature and Art during the Session 1930-1931 by numerous Societies and Government Institutions* Compiled from Official Sources. Forty-eighth Annual Issue. Pp vii + 171 (London Charles Griffin and Co., Ltd., 1931) 10s net.

THIS valuable annual consists of a classified collection of the names and addresses of learned societies, with information as to officers, conditions of membership, meetings, publications, etc., and particulars of scientific institutions controlled by Government in the British Isles. Where publications are of the nature of reports on specific subjects or special lectures, the titles are in many cases given. Brief accounts of the history and work of certain institutions are also included. The information printed is provided by officials of the bodies concerned.

In the course of the forty-seven years of its existence, the "Year-Book" has grown, and last year the publishers announced that they proposed to economise by omitting lists of papers read before societies. This has been done in the present issue, and in consequence the subtitle should have been revised. That the change has made a substantial difference is evidenced by the fact that the volume is less than half the size of last year's issue and that the price is also substantially less. We believe that the volume in its new and abbreviated form will be welcomed, with few regrets for the omissions, and we are grateful to the publishers for retaining the characteristic and substantial binding.



## Field Anthropology in Central Australia.

THE continued opening up of the central regions of the Australian continent is rapidly diminishing the opportunities for carrying out research on living Australian aborigines under their natural conditions.

The Board for Anthropological Research of the University of Adelaide has, for a number of years,

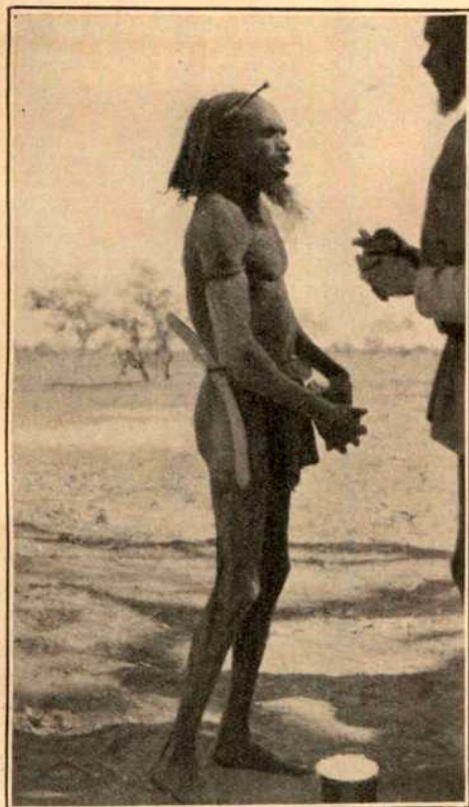


FIG. 1.—A typical bush native. Note the scars on his thigh, and the hairstring around his head, arm, and waist.

organised annual expeditions to obtain information on various aspects of aboriginal life, but concentrating more particularly on physical and physiological anthropology. The expenses of these investigations have been met, for the greater part, by funds generously placed at the disposal of the Australian National Research Council by the Rockefeller Foundation for such purposes.

The time available for this work is limited to the University vacations, falling in the more temperate seasons of the year, and it has been found that, for short periods, the most efficient and economical method of securing the desired information is by means of team work. By this method, the personnel consists of men experienced in the proposed sections of work, each worker concentrating intensively on his own special province of research. By standardisation of the work and methods of observation a considerable mass of data is recorded in a relatively short time.

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There was an expedition in August 1931 to Cockatoo Creek, situated about 185 miles northwest of Alice Springs in Central Australia. As in several previous and similar expeditions, the South Australian Museum co-operated with the University, and its representatives directed their attention to work in which they were specifically interested.

The party journeyed from the rail terminus at Alice Springs, about a thousand miles north of Adelaide, by motor transport, consisting of two motor trucks and two cars, and a further two hundred miles over the mulga plains and dry, sandy watercourses typical of such regions.

A field camp was established at Cockatoo Creek, nearly forty miles west of the areas as yet occupied by Europeans. At this site approximately one hundred and fifty natives were collected. They mainly represented the Ilpirra, Anmatjera, and Ngalia tribes. With very few exceptions, practically all these natives examined are still living their customary nomadic existence, and are entirely de-



FIG. 2.—The principals in a kwatja or water ceremony.

pendent on their own resources; thus they formed admirable material for scientific study.

In commencing these investigations each native was allotted a number; in most cases on the recent trip it was necessary to mark them with the numeral in cellulose paint, owing to the absence of any sort of clothing. The following list gives an idea of the



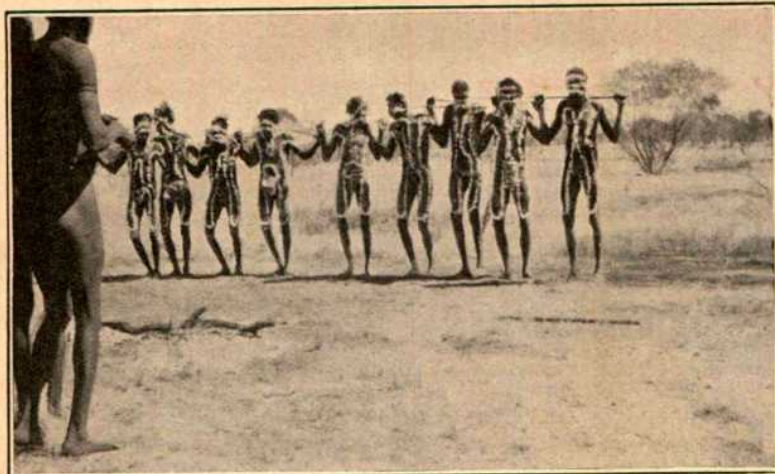


FIG. 3.—Performers in the tjilpa, a native cat ceremony.

scientific programme and the extent of the work carried out:

Genealogical data were recorded on ninety individuals. On fifty natives, routine anthropometric and descriptive anatomical observations were made. Standard photographs were taken of each individual.

The hair tracts of twenty-four children were charted. Other physical data such as skin creases, dermatoglyphs, spinal curves, and foot outlines, were secured on approximately forty individuals.

Blood grouping, entailing, with cross testing, about a thousand observations, was made on ninety natives. These results showed that sixty-four belonged to group A and twenty-six to group O.

The basal metabolism was estimated on forty-two individuals, and these, with associated tests on blood pressure, pulse, and respiration rates, etc., have produced some extremely interesting data.

On groups of individuals, varying from twenty-five to fifty in number, tests were carried out on the special senses, such as visual and auditory acuity; pain tests, strength tests, and special perception and intelligence tests were also made.

Excellent plaster casts were obtained of the faces of seventeen

natives, and also of scarred chests, of hands and feet, and of special anatomical features.

A considerable quantity of general ethnological data and photographs was secured on native customs, ceremonies, arts and crafts, as well as a valuable collection of native objects.

A vocabulary of approximately three hundred words was taken down, and native songs were recorded on phonograph cylinders. Cinematograph records were taken on both standard width and 16 mm. films, a certain amount of the latter being on natural colour film.

Although the natives were entirely uncivilised, no difficulty was experienced in obtaining their complete confidence and co-operation, a very interesting factor when it is considered that a number of the procedures, such as the routine of basal metabolism, the taking of plaster casts of the face, and the drawing of blood for blood grouping, might easily be expected to cause fear, resentment, or suspicion.

This expedition has been probably the most successful and fruitful venture that has yet been carried out in investigating the biological aspects of Australian aboriginal anthropology. The detailed results of the work will be published in due course.



FIG. 4.—Digging yelka (*Cyperus rotundus*) from the creek bank.

### Genesis of Ores in Relation to Petrographic Processes.

THE development of theories of ore genesis since their discussion at the British Association meeting in 1833 was briefly referred to in his presidential address to Section C (Geology) by Prof. J. W. Gregory. He remarked that the belief in the deep-seated origin of ores had been at one time superseded by their assignment to lateral secretion and later to the igneous rocks. He assigned the source of the lode metals to a deep-

seated zone below the level of the ordinary igneous rocks, and regarded the occasional occurrences of lode metals in them as secondary. The trend of the discussion in the Geological Section on Sept. 29 supported these views.

The conference had the advantage of being opened by Prof. G. C. Cullis, who gave a luminous exposition of the formation of ore deposits by the segregation of the more valuable metals into local



concentrations. The processes may be classified, as with rocks, into the sedimentary, of which the ore products except of iron, are relatively insignificant; the metamorphic, which are comparatively unimportant; and the igneous, which exceed the others in economic value. Prof. Cullis regards the segregation of the ores in igneous rocks as an extreme development of magmatic differentiation, and he explained the process as in most cases due to hydrothermal solutions forming mineral veins. He remarked in conclusion that although there is now a general approximation as to ore formation in the petrogenic scheme, agreement has not been reached as to the actual process of mineralisation in any one of the main metalliferous fields. This paper is being published in the Report of the Association.

Prof. P. Niggli, of Zurich, dealt mainly with metamorphic ores, as so large a measure of agreement has been reached regarding the two other groups. The magmatic ores he classified into three sections: the orthomagmatic, those formed during the main consolidation of the igneous rock; the pegmatitic-pneumatolytic, those due to volatile constituents at high temperatures; and the hydrothermal, those deposited by aqueous solutions, exhalations, thermal waters, etc. The second main group or sedimentary ores are concentrations of matter derived by the weathering of rocks, whether deposited mechanically or by solution. They are sometimes influenced by epi-metamorphism, as with the gold deposits of the Witwatersrand, which in his opinion are undoubtedly sedimentary placer deposits. He described the metamorphic ore-deposits as often characterised by a profusion of rare minerals, such as the two hundred species at the Langban mine in Sweden, more than a hundred species at the Franklin Furnace mine, New Jersey, and the varied sulpho-salts of Langenbeck in the Binnental. Remarkable mine structures are due to dislocation metamorphism, as at Rammelsberg in the Harz, and he suggests as possible examples the pyritic masses of Rio Tinto and similar deposits. The character of these ores is often due to their mechanical deformation and recrystallisation during rock metamorphism. The poverty of ores in the central Alps is due to the magmatic solutions being barred in their ascent. He urged in conclusion that the study of ore genesis is the starting-point for the estimation of the world's reserve of minerals and for the framing of future economic policy.

Prof. Percy Quensel, of Stockholm, also dealt with metamorphic ores and illustrated the need in their interpretation of dealing with the changes in the enclosing rocks by reference to the iron ores of central Sweden. His conclusions are similar to those advocated in a review in *NATURE*, Aug. 29, 1931, p. 384, of two recent Swedish monographs on these ores. These iron ores occur in the leptite formation, which consists mainly of altered acid lavas and tuffs that have been altered into granulitic gneisses. The bedded siliceous and calcareous ores in the lower part of the formation are altered sediments. The skarn ores are due to four stages: (1) metasomatic mineralisation of limestone and

dolomite; (2) formation of the 'reaction-skarn' by thermo-metamorphism with production of simple ore minerals, and local enrichments along the axes of folds; (3) intense faulting and crushing with metasomatic formation of magnesian minerals, producing 'skol' or crush-rock, and the development of albite or quartzite in the adjacent leptite; (4) local contact alteration and renewed development of skarn-minerals by the intrusion of the younger pre-Palaeozoic granites.

Such ores are therefore due more to metasomatic processes than to magmatic segregations. Dr. A. Brammall threw doubt on the primary nature of the lode metals found in granite as the results of a searching investigation of the Dartmoor granite. It contains rare gold which has been regarded, as in other cases, as a primary constituent. Dr. Brammall proved by an elaborate series of analyses and petrographic study that the Dartmoor granite has absorbed so much of the rocks into which it was intruded that the lode metals found in it may be regarded as derived from the assimilated sediments. He also threw doubt on the current theories of rock differentiation.

The lead-zinc veins of the north-eastern Pennines played a conspicuous part in the discussion on mineral veins in 1833. Current opinion on these ores was explained by Mr. K. C. Dunham, who contrasted the alternative theories—the formation of the lodes by meteoric waters dissolving ore particles from the country rocks, and their deposition by ascending deep-seated solutions. He showed that the evidence of the vertical zonal distribution of the ore, now established through the field as a whole, of the abundant fluor-spar which indicates the derivation of the ore-bearing solution from an acid magma, and of the various rare elements, all support a deep-seated origin. The surface waters, moreover, deposit only such minerals as calcite, limonite, and oxides even in the presence of abundant pyrite. The richness of the ore in the upper parts of the veins is due to the interaction there between the deep-seated and ground waters.

Mr. G. Vibert Douglas summarised the modes of origin of the chief mines of Northern Rhodesia. The Katanga type of copper and cobalt ores in dolomite he explained by an experiment he had made at N'Changa in which a solution of copper carbonate, after filtering for ten days through powdered dolomite, lost its copper; the dolomite was stained green by malachite. He attributes this type of ore, therefore, to the introduction of sulphide solutions and their concentration and deposition as carbonates. The ores of the Roan Antelope and N'Kana he attributes to the infiltration of primary sulphides, and their concentration near intrusive granite and pegmatite, and in places by deposition far from any igneous rock. The Broken Hill zinc-lead ore-bodies are pipe-like masses in dolomite. The iron-manganese ores are akin to bog iron and manganese beds, and the metals were derived from a shale that had been intruded by granite.

Dr. G. W. Tyrrell contended that it is not possible to deny the term 'magmatic' to ore deposits which

are due to the action of late magmatic residues in which water is always the predominating constituent. These deposits have been termed 'hydrothermal' by Niggli, but this usage does not distinguish between deposits of truly magmatic origin and those due to heated waters of non-magmatic derivation. There seems to be need for a term to cover the latter, although admittedly there is often difficulty in distinguishing between the two types. Perhaps the best solution would be to use the term hydrothermal for all cases of ore deposition by heated waters, and to prefix the term 'magmatic' for those in which the magmatic origin of most or all of the water is demonstrable.

Dr. Tyrrell also dealt with ore deposition and the distribution of igneous rocks, and contended that ore provinces follow the distribution of igneous provinces as between the kratogenic and orogenic regions of the crust in any given period of tectonic and igneous activity.

The complexity of origin of ores was emphasised by Prof. R. W. Brock, of Vancouver, and he welcomed Prof. Niggli's sharp distinction between ores due to the solidification of the main mass of a magma, the products of the semi-liquid extract, and the products of the fluid extract that remain in solution through a long range of temperatures. The diversity of opinions upon particular ore

deposits, remarked by Prof. Cullis, he considered satisfactory, as it shows that each deposit is being treated individually, as is necessary since more than one process is involved in most cases. Thus the Kiruna iron ores he regards as due in part to ortho-magmatic differentiation from the local syenite-porphyry, in part to later pegmatitic injection, and in part also to vein formation. He was glad that the Kiruna ore may still be considered as in part orthomagmatic, as unquestionable examples of this mode of formation are now difficult to locate. As Prof. Cullis mentioned, the nickel-ores of Sudbury are not altogether safe examples, for Dr. Cyril Knight has assembled a large number of observations that cast great doubt on their orthomagmatic origin, and Dr. T. C. Phemister has brought to light a disquieting amount of evidence that the Sudbury sill consists not of one rock showing pronounced gravity differentiation, but of two distinct rocks. Prof. Brock remarked that we can ill afford to lose this classical illustration of this possible type of ore formation, but it may be wise to prepare ourselves for such a calamity. He considers that small ore deposits are often the more instructive as to processes of formation, and that the problems of economic geology must be solved by patient and informed study in the field, laboratory work being accessory and supplementary.

### Obituary.

DR. S. E. LANE-POOLE.

WE regret to record the death of Dr. Stanley Lane-Poole, the distinguished orientalist, which took place at his residence in Brompton Square, London, on Dec. 29, at the age of seventy-seven years. Dr. Lane-Poole, who was born in London on Dec. 18, 1854, was the son of Edward Stanley Poole, of the Science and Art Department, and a great-nephew of E. W. Lane, the translator of the "Arabian Nights", the author of "The Modern Egyptians", and the compiler of an Arabic lexicon—a connexion in which he took considerable pride and emphasised by incorporating "Lane" by a hyphen in his surname.

After being educated privately, Lane-Poole entered Corpus Christi College, Oxford, in 1874, with the declared intention of devoting himself to Oriental studies. Before he took his degree in 1877, when he obtained a third class in the honours school of modern history, he was already at work in the Coin Department of the British Museum, and in 1875 had begun the publication of the Museum catalogue of Oriental and Indian coins, which was completed in fourteen volumes in 1892. He was sent by the Government on archaeological missions to Egypt in 1883 and to Russia in 1886, and from 1895 until 1897 was employed in archaeological research in Cairo. From 1898 until 1904 he was professor of Arabic at Trinity College, Dublin, acting for part of that period as secretary to the Council of the Royal Irish Academy.

The remainder of Lane-Poole's life was devoted to literary work and research. He was the author

of a number of works, some of a highly specialised character, some of a wider appeal, and of several biographies of notabilities, such as Lord Stratford de Redcliffe, Ambassador to Constantinople; Sir Harry Parkes, Minister to China and Japan; and others whose activities had been in fields in which he was interested. Two of his works of outstanding importance in Oriental studies were "Muhammedan Dynasties" (1893), a standard work of chronological reference for scholars, and the Arabic lexicon which he edited from the material amassed by Lane and published in 1893 after a labour of sixteen years. Of a large number of scholarly works dealing with the culture, art, and history of the Moslem world, the best known are "The Art of the Saracens in Egypt" (1886) and the volume on medieval India in the "Story of the Nations" series, which reached its ninth edition.

PROF. A. W. KIRKALDY.

PROF. A. W. KIRKALDY, until recently professor of economics and commerce at University College, Nottingham, and, prior to 1919, professor of finance in the University of Birmingham, who died on Dec. 29, 1931, aged sixty-four years, was one of the few British economists of the generation of teachers, now passing away, who had actual experience of routine business management for he did not enter Wadham College, Oxford, to take up academic studies until he had served in a family business in Sunderland, in many capacities, for several years. It was only natural, therefore, that

his work as teacher and as writer should be characterised by a certain impatience with the more abstract school, and by a desire to lay the foundations of economic science more securely on a basis of real fact than on speculation concerning the actions of imaginary business men and on abandoned psychological generalisations.

Prof Kirkaldy's publications include descriptive works on the British shipping industry and on the economics of transport, in addition to certain useful elementary textbooks. He was president of Section F of the British Association at the Newcastle-on-Tyne meeting in 1926, and was editor of two important reports ("British Labour", 1914-21, and "British Finance", 1914-21) of committees of inquiry set up on that occasion. These have since been published in book form, and they constitute an authoritative and a permanent record of economic movements at a most important epoch. His knowledge of business and of business men made him exceptionally welcome on councils of merchants and industrialists.

In addition to being an appointed member of several Trade Boards, Prof Kirkaldy served on the Nottingham Chamber of Commerce, taking his turn as president of that body and acting as its delegate and as economic adviser at important meetings of the Associated Chambers of Commerce. He also acted for many years as one of the honorary auditors of the accounts of the British Association. He was a valued member of the college staff at Nottingham, and he played a prominent part in the efforts there to raise the prestige of that institution and to secure a charter conferring full

university powers. His loss is one which will be seriously felt in many varied spheres.

WE regret to announce the death of Mr Francis A Towle on Jan 10, at the age of fifty-seven years. He will be remembered by a large number of scientific workers and others through his official connexion with the Royal Society, of which he had been assistant secretary since 1921, while for the preceding twenty years he had been clerk to the Government Grant Committee. Mr Towle's earlier life was spent in Birmingham. His keen, incisive manner will be missed by many fellows of the Society that he served so zealously during a period of active expansion in many directions. Outside his work, he showed great interest and skill in all kinds of mechanism, and sometimes regretted he had not devoted himself to engineering. For example, he built model locomotives that ran on miniature railway systems of his own construction, and installed electric light plant in at least one country-house. Mr Towle was also an enthusiastic photographer, and will certainly be missed in the Camera Club.

WE regret to record the death, at the early age of forty-eight years, of Marc Bridel, of the Muséum national d'Histoire naturelle and chief pharmacist to the Hôpital Lariboisière, Paris. M Bridel, a pupil of the late Prof Bourquelot, published numerous papers on vegetable glucosides and their hydrolyses by enzymes, and was a well-known figure in French chemical and biochemical circles.

### News and Views.

Prof. J C McLennan, F R S.

THE announcement that Prof J C. McLennan, dean of the School of Graduate Studies, professor of physics, and director of the Physical Laboratory at the University of Toronto, has decided to retire and make his home in England, is a matter of international concern. His resignation means the departure from Canada of one of her most distinguished men of science. Someone has said that an institution is an elongated shadow of a man. Never was this more true than in the case of the Physical Laboratory of the University of Toronto. Its achievements are the work of many men, to whom they have brought deserved recognition. None the less, the laboratory as the entity and organisation which has made it possible is a projection of the personality of Prof McLennan, and in this sense its achievements are his achievements. He became director of the laboratory under President Loudon in 1904, and professor of physics as successor to President Loudon in 1907. At that time he was the leading spirit of the Alumni Association of the University in a movement which resulted in the obtaining of permanent support for the University from the Government of the Province of Ontario. This led to the establishment of such organisations as the Faculty Union, the Students' Union, the University Press, and the erection of

Convocation Hall and the Physical Laboratory. The interest then aroused has proved to be permanent, as shown by the generous support accorded by the Government of the Province in all plans of development and expansion in the University of recent years.

UNDER Prof. McLennan's guidance, the Physical Laboratory at Toronto has contributed numerous publications that have attracted wide attention in the scientific world. At the beginning of the present century there was Prof McLennan's work in collaboration with Prof E F Burton on penetrating radiation, better known now under the name of cosmic rays. His work with Carr on spark potentials is a classic in this field. About 1910 his attention was directed to the field of spectroscopy. This resulted in a flow of papers unravelling the mysteries of the structure of spectra of many elements and the laws connected therewith. This work was temporarily interrupted by the War, when Prof McLennan was scientific adviser to the British Admiralty. On his return, new fields of research were opened up by the liquefaction of helium at Toronto. Utilising these low-temperature facilities, researches in spectroscopy were undertaken, in which it was proved that the excitation of atomic oxygen was responsible for the radiation of the well-known green line in the spectrum of auroral displays. This has stimulated further research

on the constitution and state of the upper atmosphere. The study of the spectra of gases at low temperature enabled the first experimental proof of the existence of para- and ortho-hydrogen to be established. The Raman effect with liquid gases such as oxygen, hydrogen, and nitrogen has been investigated and the crystal structure of solidified gases examined. At the present time two promising lines of research are in progress. One has to do with the evaluation of spin moments of atomic nuclei deduced from a study of the fine structure of spectral lines. The other is a continuation of a series of investigations on the superconductivity of elements and alloys. It has been found that the superconducting critical temperature is progressively lowered when currents of increasing frequency are used. This opens up an entirely new line of attack upon the problem of superconductivity.

#### Early Knowledge of Iron in the Pacific

MR. T. A. RICKARD's communication on "The Knowledge and Use of Iron among the South Sea Islanders", read before the Royal Anthropological Institute on Jan. 12, offered what may be regarded as a highly probable explanation of the fact noted by early navigators, that while the inhabitants of some of the islands showed themselves eager to obtain iron, in other islands they were indifferent. It is recorded, for example, by Wallis, Cook, and others that in the Sandwich Islands, Tonga, and Tahiti the natives were prepared to go to any lengths to get iron, whereas in New Zealand and the New Hebrides they showed no such desire. Mr. Rickard finds the clue to the explanation of this difference in statements in Mindana, a Spanish explorer, who in 1567 saw "a chisel made into a nail" in the Marshall Islands, and of a native historian of Hawaii, who in 1867 said that the Hawaiians recognised iron on Cook's ship because they "had found iron in sticks washed up on the land". Thus iron would appear to have become known in various parts of the Pacific through having been washed up in driftwood. The effect of drift in the distribution of culture in the Pacific is a subject which stands in need of closer investigation, especially in relation to the various theories of culture-distribution in that area which have been put forward. Drift has been suggested, for example, as probably an element entering into the distribution of the coconut, and some years ago the late Sir Henry Howorth was inclined to think that the adoption of red as the royal colour in Hawaii and other parts of the Pacific might have been derived from the use of that colour by the Buddhists in China and Tibet, and carried thence to the Pacific by Chinese junks which had drifted, or been driven, out of their course.

#### Glacial Man in America.

THE Division of Anthropology and Psychology of the National Research Council of the United States of America, which, by its scheme of organised co-operation throughout the middle west, is doing much to ensure the recording and preservation of objects of archaeological interest already known or casually dis-

covered, as well as to promote research, has now directed attention to the possibility of obtaining evidence relating to the existence of glacial man in America from casual or commercial excavation, especially in centres where there is evidence of glaciation. American anthropologists have been much impressed by the frequency with which relics of prehistoric man have been unearthed in Europe in the course of commercial excavation, to which the attention of the expert has been attracted, or on which the workmen have been warned to be on the look-out for anything of an unusual character.

It is a well-known fact that the evidential value of a number of archaeological finds in America, for which a special significance in prehistory has been claimed, has been vitiated by the lack of trustworthy corroboratory geological and other data. The Division of Anthropology is accordingly attempting to arouse interest in such discoveries, and to disseminate knowledge of the data required by science in relation to any chance find which may be brought to light in the course of the extensive excavations by commercial undertakings, such, for example, as the railways, in various parts of America. A conference of the leading archaeologists of the United States and representative engineers was held at Chicago in April last for the discussion of this matter, and a report has now been issued by the Council (Reprint and Circular Series No. 100). The conference adopted a scheme of co-operative research, and a number of directions were prepared to be issued in leaflet form to bodies excavating in areas where evidence of glacial man is likely to occur.

#### Multi-Channel Television.

ONE of the difficulties met in designing a new system of television is the narrowness of the frequency band of the waves permissible when only one channel of transmission is used. At the Institution of Electrical Engineers on Jan. 6, C. O. Browne showed how this difficulty can be largely overcome by using a number of transmission channels. By using five channels, the frequency band is increased five times and the difficulties of design are greatly diminished. In addition, the velocity with which the scanning spots travel over the surface of the picture is decreased and the difficulties of good synchronisation are largely obviated. To get a moderately good picture, experience shows that the picture should consist of 15,000 picture points at least, and the picture must be scanned about  $12\frac{1}{2}$  times per second. This number was chosen because the standard frequency of the supply mains in Great Britain is 50. With small screens, satisfactory results are obtained, but when a ground glass screen measuring 24 in.  $\times$  16 in. is used there is a decrease in the brilliance of the received image. With the large received picture, the effect of flicker is pronounced and a higher scanning speed than  $12\frac{1}{2}$  pictures per second needs to be used. The author has investigated the best conditions for operating the Kerr cells used in the receiver, and discusses the effects produced by geometric, non-linear, and frequency distortion.

**Electric Power in Italy.**

THE generation and distribution of electric power in Italy began towards the close of the last century. Recently, owing to the great water power resources of the country, the industry has developed very rapidly. In a paper to the Institution of Electrical Engineers read on Dec 17, Mr A Dalla Verde described the high voltage systems of Italy. In 1894 a bill was passed compelling every property owner in Italy to allow overhead or underground electrical lines for industrial use to pass through his property. There are other regulations in connexion with the use of water power, which is the property of the State. The Alps and the Apennines provide the two great sources of water power. The average flow of water in the Alpine region is a minimum in February and a maximum in June. In the Apennine region, however, the average flow is a maximum in February. The greatest amount of power is derived from the Alps. Owing to the difference in the flow characteristics of the rivers in these two mountain ranges, the combined water power available is more constant than that of either. As in England and America, the power stations are of various types, standardisation being little considered in the early days. In the high power transmission lines the pressures employed are 60, 125, 150, and 200 kilovolts. In Italy there is a strong tendency towards discarding lightning 'arrestors' altogether and experiments are being carried out with underground cables. There are many different frequencies of supply, and this makes inter-connexion with the older systems difficult. Mr Dalla Verde stated that the ratio in Italy of the steam power to the water power production of electrical energy is less than four per cent.

**Unemployed Technical Men in the United States**

In every part of the United States, various movements are under way to alleviate distress among scientific and technical men during the present unparalleled unemployment crisis. In the New York metropolitan area, local sections of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and other bodies have established the Provisional Engineers Committee on Unemployment. The chemical societies have adopted similar measures. An honorary unemployment committee has been formed, the chief function of which is to compile a register of those seeking work, and to undertake a very thorough canvass of industrial firms, etc., for suitable openings. A further important step has been taken at Columbia University, where classes in the engineering department have been opened free to all accredited unemployed professional engineers, the number being limited merely by the size of the lecture halls. A certificate is necessary showing status and confirming that the holder is out of work through no fault of his own. The principal purpose is, says Dean Barker, to preserve the morale of those skilled men during a period of enforced idleness. It is of course recognised that these various schemes are only palliative in the face of immediate necessity. They do not touch the great fundamentals of the

problem. To achieve this far greater purpose it will be urgently necessary to contemplate some form of national unemployment insurance or some nationwide plan on the lines of the Swope or Rochester or like suggestion.

**Imperial Standardisation**

THE report of the joint meeting of the British Standards Institution and the Standards Association of Australia, which was held by wireless between London and Sydney on Jan 14, has been published (C C (OC) 5929 British Standards Institution, 28 Victoria Street, S W 1). Sir George Julius, chairman of the Standards Association of Australia, emphasised the importance of the present visit to Australia of Mr le Maistre, director of the British Standards Institution, with the view of helping in the great efforts now being made to extend the Empire markets of Great Britain. That standardisation is growing very quickly in Australia is made quite clear by Sir Henry Barraclough, who stated, in support, that there are more than five hundred special and technical committees dealing with various aspects of standardisation in Australia. Standardisation must be still further developed, for, as Sir William Larke stated, it is the most effective means of securing economic production, and the greatest common measure of agreement on standardisation throughout the British Empire will ensure the greatest and most rapid development of inter-Imperial trade.

**Viscosity of Liquids.**

INTEREST has recently been revived in the subject of liquid viscosity, for many years a happy hunting-ground for framers of empirical equations. The increase of gas viscosity with increasing temperature was early accounted for on theoretical grounds, but the contrasted behaviour of liquids remained long unexplained, and theoretical bases were lacking for the equations proposed to represent the decrease of liquid viscosity with increasing temperature. Recently Prof. E N da C Andrade has put forward a theory of liquid viscosity which envisages the transference of momentum between parallel-moving layers of the liquid as accomplished through the medium of temporary unions between contiguous molecules. The picture is that of "a transitory and fluctuating crystallisation". The theory leads to a remarkably simple exponential formula for the variation of viscosity with temperature, namely,

$$\eta = A \exp (bT^{-1})$$

The formula is remarkable, inasmuch as *two* constants suffice to express the march of viscosity with temperature over the range between freezing point and boiling point. Moreover, as is readily seen, the equation provides a simple explanation of Porter's well-known relation, which states that if we determine the viscosity-temperature relation for two liquids, and take a number of pairs of temperatures  $T_1$  and  $T_2$  at which the viscosities of the two liquids are equal, then the relation between the reciprocals of  $T_1$  and  $T_2$  is linear.

MR R M DEELEY has recently printed a pamphlet in which he considers briefly the problem of viscosity



and its relation to temperature. He discusses the relation between Langmuir's view that "atoms of tungsten, molybdenum, and platinum striking a clean dry surface in high vacuum are condensed as solids at the first collision" and "have a certain average 'life' on the surface", and the statement of Maxwell that "the collision between two hard spherical balls is not an accurate representation of the encounter of two molecules. A better representation will be obtained by supposing the molecules to act on one another in a more gradual manner, so that the action between them goes on for a finite time". Mr Deeley concludes that "this finite time would appear to be Langmuir's 'life' of chemical union". Mr Deeley also describes certain experiments on stress-strain relations in a bar of pitch described by him in the *Proceedings of the Royal Society* in 1908, and points out that, so long ago as 1888, in a paper on the viscosity of ice, published in the *Philosophical Magazine*, he suggested that gravity "may give rise to a slow change of form in an elastic substance, in the interior of which liquefaction and resolidification are constantly going on".

#### Vanishing Life of Australia

THE legal position regarding the preservation of the Australian fauna is put briefly in a letter received from an Australian correspondent in comment on our leading article of Sept. 12, which aroused interest in Australian newspapers. "The enactment of laws for the protection of the Australian fauna", he says, "does not come within the powers of the Commonwealth Government, except in so far as the export of skins, etc., is concerned; but the different States have all legislated to this end in a greater or less degree. Unfortunately, the laws (or their enforcement) are not strong enough to stop the traffic which goes on, particularly in skins of our fur-bearing animals. From the number of prosecutions, it is obvious that many evasions are taking place, and the penalties imposed upon those convicted, though often heavy, apparently do not act as effective deterrents". Our correspondent includes a cutting from the Melbourne *Argus* of Sept. 18, recording the conviction of a skin-buyer of unlawfully consigning 3821 skins of 'opossums' (really phalangers, to which an American Indian word has become mistakenly applied). The fine was £955 5s, and the dealer admitted five previous convictions, including fines of £234 10s in 1927 and, with two other men, of £616 in 1929. Yet the trade apparently is worth the risk, and so long as that is so, these fur-bearing creatures stand a poor chance of retaining their foothold.

#### Interference during Pairing in Birds.

IN giving advice on the breeding of turkeys in the *Poultry World* for Jan. 1 (p. 292), Mr Edmund Burr warns breeders against allowing a cock fowl (especially a game-cock) to run with breeding turkeys, as such a bird will often interfere with them when pairing. That cocks interfere with each other's pairing is well known, but it must be exceptionally mischievous birds that extend this interference to other kinds of poultry, while it is remarkable that a bird so powerful

and fierce as the turkey-cock permits it, especially as, unlike the fowl, he has his beak free during the act, not using it to grip the hen. M. G. Rogeron, however, in his very instructive book "Les Canards", records a similar case in which a garganey drake, infatuated with female mandarin ducks, interfered with pairing with impunity, although the mandarin drake is larger and very high-spirited, being well able to hold its own with mallard. Interference with pairing by their fellows may be the reason why the act is observable with comparatively few birds; it is not practised by the rook, but is a perfect *mama* with the house-crow of India—so much so that in eight years' bird-watching there, the writer of this note never saw the act successfully performed by that species.

#### A Prismatic Derivator.

FOR many purposes, both in physics and engineering, the derivative of a graphical record has to be taken with all the accuracy that the record allows. For this purpose, either a numerical method of differencing is usually resorted to, or a mechanical process of laying a tangent. Perhaps the best known of this latter type is that which depends on the principle that a curve and its reflection in a plane mirror pass continuously into one another when the reflecting surface lies along the normal. A prismatic derivator has been designed by v. Harbou and has been produced by Askania-Werke A.G., Bambergwerk, Berlin-Friedenau, which avoids the difficulty usually experienced of recognising when a curve and its reflection are continuous. In this new instrument a right-angled prism is placed with its hypotenuse on the paper and with the intersection of the opposite edge approximately along the normal to the curve. The portions of the curve on each side of the point at which the tangent is required, as seen after refraction through the prism faces, will not join up at the prism edge unless that edge is accurately along the normal. From the published description of the instrument, it appears that there is a number of other adjuncts that tend to increase the accuracy and effectiveness of the apparatus.

#### Photographic Research.

"ABRIDGED Scientific Publications" from the Kodak Research Laboratories, vol. 14 (1930), issued by the Eastman Kodak Co., Rochester, New York, contains, in *précis* form, a number of papers previously published in various journals. An introductory note states that the Eastman Kodak Co. does not restrict publication to a privately issued journal but desires that the results of its scientific research may be easily accessible to all interested in special branches of science. The papers cover a wide range of subjects, including physics (for example, a study in condensation pumps, and a polarising apparatus for determining extinction angles), physical chemistry (for example, the lattice energies of silver halides, the electrolytic oxidation of some photographic developers), organic chemistry (for example, the preparation of *s*-diphenylcarbazide, a colour reaction for naphthol yellow), and colloid chemistry and photographic



technique. The volume brings together a large amount of research work of high standard, the results of which will be of value in many fields. Even biology is represented in a description of the production of a motion picture showing the movements of the vocal cords in the larynx.

#### Announcements.

THE twelfth International Congress of Zoology will be held at Lisbon in the summer of 1935, under the presidency of Prof. Arthur R. Jorge, professor of zoology in the University of Lisbon.

THE Duddell Medal for the year 1931 has been awarded by the council of the Physical Society to Prof. C. T. R. Wilson, Jacksonian professor of natural philosophy in the University of Cambridge.

PROF. ARTHUR HOLMES, professor of geology in the University of Durham, sails from England on Feb. 20 to deliver a course of eight lectures on "Radioactivity and Geology" at the Lowell Institute of Boston, Mass. The lectures begin on March 4. Prof. Holmes will also give a lecture on "The Age of the Earth", before the Royal Canadian Institute at Toronto, on April 2.

IT is announced by Science Service, of Washington, D.C., that Dr. John J. Abel, professor of pharmacology in the Johns Hopkins Medical School, Baltimore, Md., was elected president of the American Association for the Advancement of Science meeting at New Orleans, in succession to Dr. Franz Boas, the distinguished anthropologist of Columbia University. Dr. Abel was the first to obtain in chemically pure state the secretion of the suprarenal glands, to which he gave the name epinephrine, also known as adrenalin. He was also successful in isolating the active principles of the pituitary gland and was the first to obtain insulin in crystalline form. The prize of 1000 dollars offered for a paper read at the annual meeting of the American Association has been awarded to Dr. C. C. Speidel, of the University of Virginia, for a paper on the development of nervous tissue.

THE Council of the Geological Society has this year made the following awards: Wollaston Medal to Prof. J. H. L. Vogt, of Trondhjem, Norway, in recognition of the value of his researches concerning the mineral structure of the earth, and especially his pioneer work in the application of physical chemistry to the origin of igneous rocks and ore-deposits; Murchison Medal, together with the sum of ten guineas from the Murchison Geological Fund, to Prof. William G. Fearnside, in recognition of the value of his researches in the Lower Palaeozoic rocks of Wales and other geological investigations; a Lyell Medal, together with the sum of £30 from the Lyell Geological Fund, to Mr. Henry Dewey, in recognition of the value of his researches in the geology of the south-eastern parts of England, more especially the Quaternary deposits of the London Basin; another Lyell Medal, together with a like sum of £30 from the Lyell Geological Fund, to Dr. M. M. Ogilvie Gordon, in recognition of the value of her researches on the

structure of the Western Dolomites (Tirol); the balance of the proceeds of the Wollaston Donation Fund to Dr. Ernest Neaverson, in recognition of the value of his researches in the structure and geological history of the Cephalopoda; the balance of the proceeds of the Murchison Geological Fund to Dr. A. K. Wells, for his contributions to petrology, and more particularly for his researches on the Ordovician igneous rocks of parts of Wales and the plutonic rocks of the Channel Islands; the balance of the proceeds of the Lyell Geological Fund to Mr. R. W. Pocock, in recognition of the value of his geological work on the older rocks of the Welsh borderland.

MESSRS. Longmans and Co., Ltd., announce for early publication "The Causes of Evolution", Prof. J. B. S. Haldane; "Sulphur Bacteria", Prof. D. Ellis; "Vision and Colour Vision", Dr. R. A. Houstoun; and "Modern Practice in Mining", Sir Richard Redmayne—Vol. 5: "Colliery Machinery and its Application".

PROF. F. SODDY is publishing through John Murray a new work entitled "The Interpretation of the Atom", which will take the place of the same author's "Interpretation of Radium". It will be in two parts, dealing respectively with the radioactive elements and isotopes, and the general progress of atomic chemistry.

WE have received a copy of a prospectus describing a facsimile edition of the most ancient manuscripts and maps of Ptolemy. The work, which is to be published in an edition of 350 copies by E. J. Brill, of Leyden, and O. Harrassowitz, of Leipzig, is edited by Dr. J. Fischer, who discovered in the Codex Urbinae Graecus 82 of the Vatican Library the oldest Greek maps and text of Ptolemy. These twenty-seven maps, which hitherto have not been published, are now reproduced full size. The work will also contain, in addition to the Greek text in full, twenty-seven maps of the oldest Latin manuscript, a large number of maps from various Greek and Latin manuscripts of Ptolemy giving all the known types, a monograph on the life and works of Ptolemy by Dr. Fischer, and a critical introduction to the Greek text. There will be four volumes, including one of folio size.

MESSRS. W. JUNK, of Berlin, publishers and dealers in second-hand books and pamphlets, have issued a sumptuous catalogue of their publications and stock. Zoologists need not to be reminded of the invaluable monographs which Messrs. Junk have made available for reference—the series of "Catalogi Coleopterorum, Lepidopterorum, Fossilium", and the six-volume "Tabulae Biologicae", which stands by itself as a work for consultation in its particular sphere. Almost exactly half the present book catalogue of 290 pages deals with the natural history publications of the firm, and the other half contains a list of second-hand books and pamphlets. The extent of the second-hand collection may be gauged by the fact that a single page is devoted to the briefest summary of a series of 75,000 papers on zoology, botany, palaeontology, geology, and mineralogy, which is priced at £1275.



### Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

#### *Ovis astore*, a Three-Coated Sheep.

ABOUT 1912 the many interesting experiments in sheep-breeding carried out at Colesbourne by the late H. J. Elwes directed the attention of both sheep breeders and wool users to the many types of sheep, wild and domesticated. It was left to Prof. Cossar

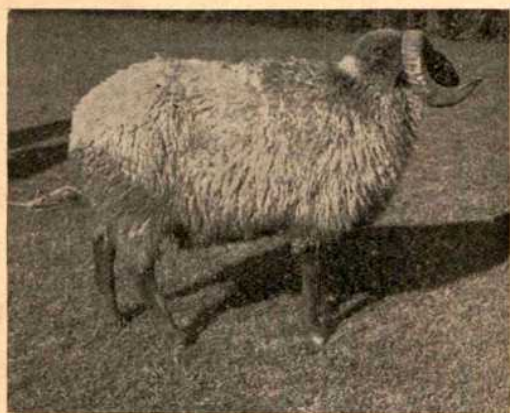


FIG. 1.

Ewart, of the University of Edinburgh, to evolve from the primitive characters and types a key scheme explanatory of the origin of the present-day breeds of domestic sheep. This he did by referring all breeds back to two fundamental types, namely, the Urial-Mouflon, which still has representatives in Asia, Europe, and America, and the fat-tail-fat-rump, based on the *Ovis ammon*, which seems to be a special development to meet the changed environment follow-



FIG. 2.

ing the drying up of the Gobi Sea. Many evidences of these two types of sheep are to be noted in carefully selected present-day flocks (see NATURE, May 6, p. 595; 1922).

Turning from an examination of the body contour

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of the various domestic sheep, Prof. Ewart next considered the woolly coat and at once made the discovery that the wild sheep is usually double-coated, carrying an outer coat of long, coarse fibre and an under coat of very fine fibre, and that the coats of many of the domestic breeds can be explained by postulating the casting of the outer coat of hair and the development of the under coat of wool. In 1923, during the meeting of the Pan-Pacific Congress in Sydney, attention was first directed to the fact that even our finest woolled sheep, the merino, usually carries a double-coat at birth, but that within a few weeks it casts the hair-coat, possibly as kemps, and becomes single-coated.

Since these facts and suggestions were put forth, endeavours have constantly been made to refer back every class of fleece to the double-coated type; but from time to time difficulties have been encountered, scarcely consciously realised, in doing this.

While in Srinagar (Kashmir) last July, a sheep was brought from Astore (Gilgit) for my inspection (Figs. 1 and 2) which seems to throw a flood of light upon the difficulties from time to time encountered, and may result in a more perfect explanation of the varying coats of our domestic sheep than has been

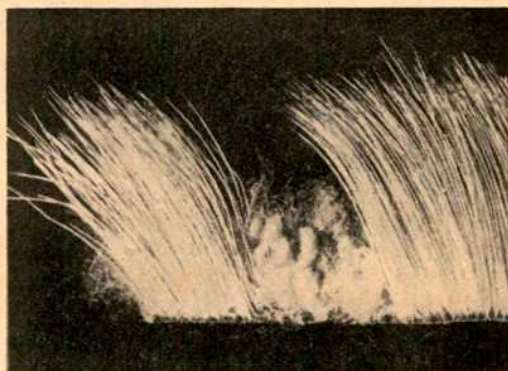


FIG. 3.

offered by attempting to refer every type back to the two-coated sheep (Fig. 3). The general appearance of the *Ovis astore* is black with bleached fibre tips, but I was surprised, on examining a staple of wool, to find that this appearance is due to a long, strong white fibre thrusting itself through an under coat of strong brown or black fibre, and that in addition to these two coats is a third coat of fine white wool. Careful measurements of these three types of fibres have been made, with the following result:

| Fibre Type.       | Minimum Diameter (in.). | Maximum Diameter (in.). | Average Diameter (in.). | Approx. per cent.* |
|-------------------|-------------------------|-------------------------|-------------------------|--------------------|
| White outer coat  | 1/582                   | 1/339                   | 1/447                   | 12                 |
| Black under coat  | 1/700                   | 1/223                   | 1/397                   | 17                 |
| White middle coat | 1/1170                  | 1/552                   | 1/742                   | 71                 |

\* This appears to vary according to the position selected on the sheep.

If a hundred measurements of each type of fibre are made and the results plotted as a diameter frequency distribution curve, the result shown in Fig. 4 is obtained.

The curves for each type of fibre show that the white outer coat and the white middle coat fibres come on to much shorter bases than the base of the black under coat fibres and are almost equally distributed on either side of the mode, as against the



black fibres, which, extending in an extraordinary manner towards the coarse end of the scale, are anything but balanced. The three scales overlap, but the fibres seem sufficiently distinct in appearance to warrant them being put into these three distinct classes.

As these sheep are sheared twice a year, it has not been possible to ascertain how the coats are shed. This particular sheep, however, is kindly being kept under observation by Mr C R Kohh, Director of Industries for the Kashmir State, and within twelve months definite details of the shedding or non-shedding of the coats will be available. It will be noted that the head of the sheep is of the *Ovis polii* type, and an endeavour is being made to link the three coats up with the *Ovis polii* type of sheep, as distinct from the *Ovis ammon*.

This discovery leads to many important questions, of which perhaps the most important is: Can the types of fibres produced by the sheep be linked up in any way with the skin structure? The opinions of

to the present, we are really in a dilemma, although most authorities have accepted the first explanation. *Ovis astore*, however, seems likely to solve this dilemma.

ALDRED F BARKER

University of Leeds,  
Dec. 5

#### Death of Fish in the Tees Estuary.

For several years past, migratory fish passing through the Tees estuary have been killed in large numbers. This is most noticeable in the months of April, May, and June, during the seaward migration of young salmon (*Salmo salar* L.) and sea trout (*Salmo trutta* L.), when many thousands are found dead on the foreshore. An extensive biological, chemical, and hydrographical survey of the river, undertaken by the Department of Scientific and Industrial Research as part of the programme of the Water Pollution Research Board, has provided an opportunity for an investigation into the cause of this mortality.

The estuary is polluted by the untreated sewage from a population of about 275,000, and by large volumes of industrial wastes, produced mainly in the processes associated with the iron and steel industries, and consisting chiefly of coke oven effluents and spent pickle liquors from galvanising plants. As a result of this pollution, the waters of the estuary are partially deoxygenated, the deficiency increasing with increasing water temperature, and reaching values as low as ten per cent of saturation at maximum summer temperature. During the months April, May, and June, however, when the smolts are killed, the dissolved oxygen deficiency is usually insufficient to account for the mortality. An examination of the directly toxic effluents entering the estuary was, therefore, undertaken.

Spent pickle liquors contain about forty per cent of ferrous

chloride in acid solution, and in the alkaline waters into which they are discharged the iron is almost immediately precipitated. In the concentrations in which they occur, these effluents have no appreciable effect on the toxicity of the estuary.

Coke oven effluents, on Tees-side, are of two kinds, resulting from the semi-direct and direct processes of ammonia recovery. By a series of experiments, in which the various groups of substances found, by analysis, to be present were each in turn eliminated, the toxicity of the semi-direct process effluents was shown to be due mainly to phenolic bodies, and that of the direct process effluents to cyanides.

The concentrations of both tar acids and cyanides normally present in the estuary are of the order to be expected from the volumes of effluents discharged and the volume of estuary water available for their dilution. The concentration of tar acids present, except in very restricted areas, is never sufficiently high to be toxic to fish, but cyanide is frequently found in lethal concentrations in the general body of the estuary water.

During the smolt migration of 1931, water samples from the mortality zone of the estuary were collected every day, their dissolved oxygen and cyanide contents were determined, and their toxicity to trout was measured by experiment. The oxygen concentrations ranged from forty to seventy per cent of saturation (water temperature 10°-14° C), and were too high

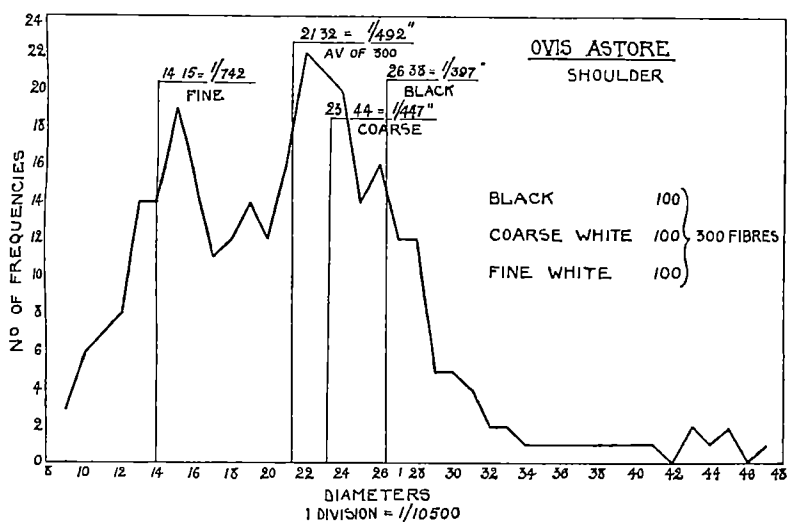


FIG 4

physiologists on this matter would be very valuable. If a small staple of fibres is pulled from a merino sheep, it has been observed that it brings with it the complete embedding skin. The wool of the normal British sheep seems more deeply embedded in the skin, and, so far as I am aware, a staple pulled away never brings the skin with it. This suggests that fine wool fibres grow shallower in the skin than the coarser wool fibres or hairs.

There is, however, an even more interesting problem involved. The blackface breed of sheep appears to grow the double coat, an outer coat of strong fibre and an under coat of fine fibre. The under fine coat is shed each year, usually in the late spring, whereas the outer coat is never shed, or at least never shed as one complete coat. Now, the coat of the merino sheep is supposed to be based upon the elimination of the outer coat of hair and the development of the under coat of wool. But, as we have already noted, the merino sheep, as a lamb, sheds its outer coat of hair but will retain its under coat of wool for five or more years without evidence of any break along the fibre length. Hence the question arises: Is the coat of the merino based upon the under coat of the wild sheep with a suppression of the shedding factor? Or is the coat of the merino sheep, after all, a modification—a most marked modification—of the outer coat of the wild sheep, the under coat being eliminated? Up

to account for the observed mortality. It was found that the toxicity increased with increasing cyanide concentration. In 130 out of 138 toxic samples the toxicity was completely removed by the addition of a small quantity of formaldehyde, which removed the cyanide present by forming with it innocuous compounds, but did not alter the tar acid or dissolved oxygen concentrations. The colour of the gills of smolts dying at the surface of the estuary waters was found to be markedly brighter than that of normal fish. It was shown experimentally that, of the poisons likely to be present in the estuary, cyanide alone produced this effect.

The evidence therefore points to the conclusion that cyanide is the factor mainly responsible for the death of fish in the Tees estuary. The importance of cyanides in the study of pollution has been noted by Lehmann,<sup>1</sup> but his work has attracted little attention in Great Britain.

A method whereby cyanide-containing effluents from coke ovens are rendered innocuous by the addition of spent pickle liquors is being worked out, and it is hoped that treatment on a works scale will soon be possible.

B. A. SOUTHGATE  
F. T. K. PENTELOW  
R. BASSINDALE

The Marine Biological Association,  
Cleveland Shipyard,  
Middlesbrough, Dec. 24

<sup>1</sup> Lehmann, C, *Z. Fischerei*, 24, 401, 1926

#### A New Series of Allelomorphs in Mice.

THERE appeared recently<sup>1</sup> a paper by P. J. Cammidge and H. A. H. Howard on "The Hereditary Transmission of Hypoglycæmia in Mice" which contains facts of considerable interest to students of genetics. These authors had previously shown that the condition of high blood sugar in mice (hyperglycæmia with blood sugar values of 110-125 mgm per 100 c.c. of blood) behaves as a simple recessive to the normal condition (about 80 mgm).<sup>2</sup> They have now found mice with very low blood sugar value (about 60 mgm), and this condition also behaves as a simple recessive to the normal. Segregation in both cases is clear, no intermediate values having been found.

The experimental evidence, allowing for a lower viability of hypoglycæmic animals, seems sufficient to justify the authors' conclusions that they have discovered another recessive gene influencing the blood sugar level of the blood. They seem, however, not to have noticed the important fact that the three blood sugar levels—high, low, and normal—appear from their evidence to be due to three allelomorphic conditions of the same gene. A summary of the crosses which show this follows.

High  $\times$  normal  $F_1$ , normal,  $F_2$ ,  $\frac{3}{4}$  normal,  $\frac{1}{4}$  high (actually 81/28)

Backcross,  $F_1 \times$  high,  $\frac{1}{2}$  normal,  $\frac{1}{2}$  high (actually 45/44)

Low  $\times$  normal;  $F_1$ , normal,  $F_2$ ,  $\frac{3}{4}$  normal,  $\frac{1}{4}$  low (actually 45/10 + 5 dead)

Backcross,  $F_1 \times$  low,  $\frac{1}{2}$  normal,  $\frac{1}{2}$  low (actually 77/26 + 40 dead)

Low  $\times$  high,  $F_1$ , high,  $F_2$ ,  $\frac{3}{4}$  high,  $\frac{1}{4}$  low (actually 46 high, 10 low + 6 dead)

If the mice born dead are assumed to be hypoglycæmic, the results fit the expectations remarkably well. But the results of crossing low by high show that these conditions are not only allelomorphic with normal, but also are probably allelomorphic with each other as well. Normal, high, and low appear to form

a series of triple allelomorphs with dominance in the order given. This dominance order is unusual, if not unique, among multiple allelomorphic systems, since a high quantitative effect on blood sugar appears between two lower values. Further evidence from crosses of high by low and of each by the same normal stocks would seem desirable to test the possible influence of modifying genes in producing this unusual result.

L. C. DUNN

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<sup>1</sup> *Proc. Roy. Soc. Med.*, vol. 23, 1930

<sup>2</sup> *J. Genetics*, vol. 16, 1926

THE case to which Prof. Dunn alludes is of very great interest in the question of the origin of dominance. It will be observed that the gene for normal blood sugar is dominant both to the hyperglycæmic and to the hypoglycæmic genes. In the "Genetical Theory of Natural Selection" (Chap. v), I had inferred that such dominance in opposite directions to different mutants must occur in quantitative characters, if dominance is, as I believe, a product of natural selection. With respect to the exceptional dominance of the one mutant gene over the other, it will be observed that this also follows the rule of the dominance of the more over the less viable condition. It is much to be hoped that further evidence of this observation will be obtained, using genetically normal, wild type mice, since the fact that in this cross an intermediate heterozygote would seem to be more advantageous than one with high blood sugar, suggests that the case may throw light on the mechanism by which the recessiveness of hypoglycæmia has been brought about.

R. A. FISHER

Rothamsted Experimental Station,  
Harpenden

#### A Fertile Mule.

ON Nov. 24, 1924, a common mule on the farm of Mr. W. J. Kilian, of Weenen, Natal, gave birth to a male foal, and a detailed account of the occurrence was given in the *Annals of the Natal Museum*, vol. 5, pt. 5, 1926. The mule in question was bred by Mr. W. L. Eales, of Fullerton, Cape Province. It is a typical mule in every way, and has a considerable preponderance of the characters of the ass.

The foal was suckled by the mother mule. The foal grew rapidly and the adult animal is now a reliable riding horse, and from the accounts received it is practically indistinguishable from a pure horse.

The subject has again been brought to my notice, in that on Nov. 21 of this year the same mule, which is about fifteen years old, gave birth to a second male foal, and this foal was sired by a different stallion from that of the first foal. Thus, between the births of the two foals there has been an interval of seven years, although the mule has been repeatedly served. In the present foal the characters of the horse would appear to be markedly prepotent over those of the mule, just as in the case of the first foal.

It would seem as though South Africa were in some way favourable for mule-fertility, in that in 1904 the late Dr. Gunning, director of the Transvaal Museum, informed me that he was acquainted with an undoubted case in the Transvaal, but, so far as I am aware, the exact details were never published.

That the common mule may be sometimes fertile has been long disputed, although certain alleged cases have been quoted from America, but they mostly seem to lack strict authenticity. Also, on cytological grounds even the possibility of back-crossing

has been questioned, owing to the fact that a highly confused chromosome complex has been found in the mule

There is here, however, an indisputable case of mule-fertility, and the theoretical assumptions are thereby shown to be invalid

ERNEST WARREN

Natal Museum, Pietermaritzburg,  
Nov 22

### Vocal Powers of Kangaroos.

IN the notes on Sir Peter Chalmers Mitchell's address to the British Association on "Zoos and National Parks",<sup>1</sup> the statement is made that the "kangaroo is never known to utter any kind of sound normally", etc. This is misleading, as, under entirely 'normal' conditions, kangaroos of several species, both 'in the wild' and in captivity, frequently make two distinct sounds and occasionally a third

(1) A soft, frequently repeated, 'chittering' sound, made without perceptible movement of the lips and possibly produced by expulsion of air through the nostrils. In pet kangaroos it is frequently produced when the animal responds good-humouredly to gentle teasing, but amongst the gregarious small wallabies (*Thylogale*) a very similar sound is used by females to recall young to the pouch

(2) A loud, discordant, aspirate sound, which may be roughly imitated by the long-drawn-out enunciation of the word 'harsh'. Chiefly indicative of anger and of pain, it is almost always heard when a wounded male is approached, and is sometimes used also by the rutting bucks, in the concluding phases of their pursuit of the females

(3) A distinct, short, clear-cut bark or cough, made as a warning signal by a member of a 'mob', when suddenly disturbed. Although mentioned more than once in the older literature on Australian natural history, it is not given much credence here, but I can vouch for its reality from personal experience, having heard it on two occasions, in Gippsland and southern New South Wales, when observing parties of *Macropus giganteus typicus* at close quarters in heavy timber, and once (by *M. giganteus fuliginosus*) in the Zoological Gardens at Adelaide

H. H. FINLAYSON

South Australian Museum,  
Adelaide,  
Nov 22, 1931

<sup>1</sup> NATURE, 128, 578, Oct 3, 1931

### St Kilda House Mouse.

THE St Kilda house mouse (*Mus musculus muralis*, Barrett-Hamilton) received great notoriety when the island was evacuated in 1930, because it was confidently expected to become extinct. Some previous writers (Ritchie, *Scot Nat*, 1930) stated that the mouse was confined to the Post Office buildings on the island. A visit to St Kilda this summer proved to us that the mouse has become extremely rare and at present only inhabits two houses in which food was left behind. It is particularly interesting to note that neither of these houses is the Post Office, and the evidence of the inhabitants, and of previous visitors, confirms the view that the mouse was never confined to one building.

Waterston (*Ann Scot Nat Hist*, 1905) described a number of house mice from Lochmaddy, N. Uist, which in every way resembled the light-bellied *Mus musculus muralis*, and were found living with the normal *Mus musculus*, but apparently without hybrids. This discovery seems to have been overlooked by sub-

sequent investigators, and points to the mouse not having such a confined geographical distribution as is generally credited to it

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Leeds

### Cytology of Mycetozoa

IN her paper entitled "The Life-History and Cytology of *Didymium nigrupes* Fr",<sup>1</sup> Dr E. J. Cadman has made a valuable contribution to the literature on Mycetozoa. The principal points described by her are the following: the active swarm-cells possess what she terms a "centroblepharoplast" and cone apparatus connecting the flagellum with the nucleus; the nucleus of the swarm-spores has four chromosomes; a definite myxamœboid stage occurs when all trace of cone-apparatus disappears; the myxamœbæ unite in pairs as gametes to form a zygote or young plasmodium, and their nuclei also fuse; the fusion nucleus contains eight chromosomes; a diploid number characteristic of all succeeding nuclei of the plasmodium; meiosis occurs in the nuclei of the young sporangium before spore-formation, when a heterotypic division with four U-shaped chromosomes is swiftly followed by a homotypic division with four nearly spherical chromosomes.

Schunemann,<sup>2</sup> working with the typical form of *D. nigrupes*—Dr Cadman deals entirely with var. *xanthopus* of that species—also observed the union of myxamœbæ to form gametes, but he did not see fusion of their nuclei; he also describes meiosis in the nuclei of the young sporangium before spore-formation. He found the number of chromosomes in the nuclei of the swarm-cells and plasmodium to be eight and sixteen respectively. It is interesting that the var. *xanthopus*, a variety apparently closely allied to the typical form, should be found by Dr Cadman to possess only half the number of chromosomes in those two stages.

By way of criticism, several points may be noted. Dr Cadman says (p. 106) that "the spore-membrane consists of a single membrane, not a double one as stated in Lister's Monograph". The statement is undoubtedly too general and should have been qualified; double spore-walls occur, however, in several species of the genus *Didymium*, in *Mucilago*, and in species of *Trichia*, as observed by De Bary<sup>3</sup> and others. Dr Cadman disregards the numerous completely satisfactory monospore cultures carried out by Jahn<sup>4</sup> in *Didymium squamulosum* Fr., and by Miss Cayley<sup>5</sup> and also by Schunemann in *D. nigrupes* and *D. difforme* Duby, when all stages in the life-history, the germination of the spore, the increase of swarm-cells, and the formation of healthy plasmodia and sporangia were followed. Dr Cadman seems scarcely to give due weight to the observations of Miss Cayley and Miss Waterhouse, who succeeded in watching in thirteen instances the gradual fusion of flagellate gametes in living monospore and plurispore cultures of *D. difforme*. She is not quite correct in stating that Miss Cayley considers that sex-segregation is closely connected with meiosis, for, although Miss Cayley's diagram illustrating the stage at which sex-segregation might occur is rather misleading, she writes (l.c. 245), "there is no experimental proof that the first division of the emerging swarm-spore is the critical one as far as sex is concerned", and indeed her view is that, although the evidence is not conclusive, her observations, and Jahn's, tend to show

that sex-segregation does not take place at meiosis Dr Cadman herself is of the opinion that in the two species of Mycetozoa she has investigated, *D. nigripes* var. *xanthopus* and *Reticularia Lycoperdon* (Bull.), "there is no difference, morphological or physiological, between the gametes in either species."

In conclusion, it may be said that anyone who has worked at the cytology of this group will appreciate the technical difficulties that are involved in its investigation.

G LISTER  
871 High Road, Leytonstone, E 11,  
Dec 13.

<sup>1</sup> *Trans. Roy. Soc. Edinburgh*, 56, 93-142, 1931

<sup>2</sup> "Untersuchungen über die Sexualität der Myxomyceten", *Planta*, 9, 645-672, 1930

<sup>3</sup> "Comp. Morph. and Biol. Fungi, etc.", Oxford Ed., p. 441, 1887

<sup>4</sup> "Myxomycetenstudien 8", *Ber. Deutsch. Bot. Gesellsch.*, 29, 239, 1911

<sup>5</sup> "Observations on Mycetozoa in the Genus *Didymium*", *Trans. Brit. Myc. Soc.*, 14, 227-248, 1929

### Carbon/Nitrogen Ratios in Cacao Soils.

By tabulating and comparing the results of a detailed laboratory examination of profile samples of cacao soils collected in January 1930, in the island of Tobago, British West Indies, one of us (G. G.) was able to demonstrate<sup>1</sup> a close correlation between the yielding capacity and the carbon/nitrogen ratio for the organic matter contained in the surface six-inch layer of soil. The mean ratio for 'good' soils yielding more than 8 bags (or 1320 lb.) of fermented and dried cacao beans per 1000 trees (pickets) is 8.3 (21 samples), and for 'bad' soils yielding less than 8 bags per 1000, 6.8 (10 samples). Statistically, this correlation is highly significant ( $t=4.5$ ), and the C/N ratio is not necessarily dependent on the total amount of organic matter present ( $t=1.1$ ). Although a complete explanation of this relationship is not yet forthcoming, the result implies that the nature of the organic matter present, rather than its total amount, is the primary factor concerned in the productivity of cacao soils under the climatic, cultural, and soil conditions that obtain in Tobago.

Afterwards, similar comparisons of yields and C/N ratios for cacao soil—profile samples collected in Trinidad and in Grenada, B. W. I.—have been established. The following additional results have been demonstrated.

|                          | Mean C/N Ratios (Top 6 in Soil)                         |                                                        |
|--------------------------|---------------------------------------------------------|--------------------------------------------------------|
|                          | 'Good' Cacao Soils<br>(Yield, more than<br>8 Bags/1000) | 'Bad' Cacao Soils<br>(Yield, less than<br>8 Bags/1000) |
| Trinidad                 | 7.0 (54 samples)                                        | 5.7 (46 samples)                                       |
| Grenada                  | 8.0 (23 samples)                                        | 6.5 (12 samples)                                       |
| (Tobago, for comparison) | 8.3 (21 samples)                                        | 6.8 (10 samples)                                       |

Whilst these results substantiate the earlier Tobago result, the numerical values of the C/N ratios for the Trinidad and the Grenada soils are not identical with those for the Tobago soils, but they are of the same order of magnitude, and their differences are approximately the same.

A comparison of the climatic, cultural, and soil conditions within the three areas is instructive. The climatic differences are not very marked. Within each area, the annual rainfall (45 to 120 inches) is distributed between seven wet months (June to December) and five dry months. The cultural treatment is somewhat similar, except that leguminous shade trees (*Immortel*) are generally grown in the cacao fields of Trinidad and Tobago, but not in those of Grenada, whilst artificial manures are regularly employed in Grenada but not in the other islands. The soil types

are markedly different. The cacao soils of Trinidad are mainly derived from Tertiary sedimentary rocks and from their recent alluvial representatives, but some alluvial soils of the Northern Range of mountains are derived from Palaeozoic dynamo-metamorphosed sediments. The cacao soils of Tobago are about equally distributed between—(a) metamorphic sedimentary rock types, similar to those of northern Trinidad, (b) partly metamorphosed, intrusive basic igneous rock (epidiorite) types, and (c) alluvial equivalents of both. The cacao soils of Grenada are derived from Pleistocene basic volcanic rocks (hornblende and augite andesites and olivine basalts, lavas, intrusions, and fragmental rocks) or their alluvial derivatives. Detailed studies of all these soil types are now being prosecuted at the College, and include a special investigation of the transformations of their organic matter contents. It is hoped thereby to discover the true significance of the C/N ratio of soil organic matter in its relation to nutrition of the cacao tree.

F. HARDY  
(Imperial College of Tropical  
Agriculture)  
G. GRIFFITH  
(Dept. of Agriculture, Uganda)

Trinidad, Nov. 28

<sup>1</sup> Unpublished Thesis in part fulfilment of the requirements of the Associateship of the Imperial College of Tropical Agriculture, Trinidad, B. W. I., session 1929-30.

### Raman Lines and Infra-Red Bands in Nitrous Oxide.

THE question whether or not the  $N_2O$  molecule is linear, and if so, whether the oxygen atom occupies a position between the two nitrogen atoms or at one end, was discussed by Snow<sup>1</sup> some time ago. The incomplete evidence then available seemed to favour the symmetrical configuration. We have, however, been able to show conclusively that the molecule is unsymmetrical, though linear.<sup>2</sup> The form of the bands and the spacing of the rotation lines is inconsistent with any but the linear model. The selection rules for vibrational transitions and for the appearance of zero branches, and the fact that all three fundamental frequencies are optically active, indicate the asymmetry.

The lowest frequency fundamental vibration, designated as  $\nu_2$ , involves simultaneous displacements of the three atoms perpendicular to the linear axis, the central atom moving toward one side and the extreme atoms toward the other. Dennison<sup>3</sup> has shown that in the first excited state each atom executes a circle about its normal position as centre. The molecule thus becomes a very slender rotating triangle the lengths of the sides of which *do not vary*. Consequently there is no change in polarisability with phase, and, according to Placzek,<sup>4</sup> no Raman scattering. A second fundamental frequency, designated as  $\nu_1$ , involves simultaneous displacements of the two extreme atoms towards and away from the centre, with rapid changes in polarisability, and should give an intense Raman line. We find this band in the infra-red at  $1285\text{ cm}^{-1}$ .

The third fundamental frequency,  $\nu_3$ , which we find at  $2224\text{ cm}^{-1}$ , involves displacements of both extreme atoms in one direction along the axis and of the central atom in the opposite direction. If the molecule were symmetrical (both extreme atoms identical) the configurations at phases one-fourth and three-fourths would be mirror images of one another. At zero phase the polarisability would be either a maximum or a minimum, the sequence of values assumed during half of the period being repeated precisely during the next half period. Thus no Raman displacements of the fundamental frequency would occur. For the



unsymmetrical molecule, however, this would not be the case, and Raman lines would be expected, though perhaps with low intensity

The observations of Bhagavantam<sup>5</sup> corroborate in a satisfactory manner our conclusions regarding asymmetry. He finds an intense Raman line with the displacement  $1283\text{ cm}^{-1}$ , and a rather weak line with the displacement  $2226\text{ cm}^{-1}$ , in very good agreement with our values for  $\nu_1$  and  $\nu_3$ . The former corresponds to the intense scattering in  $\text{CO}_2$  associated with the symmetrical and optically inactive vibration at about  $1338\text{ cm}^{-1}$ , but for the latter  $\text{CO}_2$  has no counterpart, in spite of the fact that its strongest infra-red absorption band occurs at  $2349\text{ cm}^{-1}$ .

Because of the small energy and double weight of the first vibration state  $\nu_2$ , a large fraction of the  $\text{N}_2\text{O}$  molecules (about one-eighth) are excited to this level at room temperature. The Raman displacements for light scattered by these excited molecules would be slightly different from those for normal atoms, giving rise to satellite lines. From combination relations we are able to predicate the positions of these weaker lines, not yet observed, their displacements should be  $1278\text{ cm}^{-1}$  and  $2210\text{ cm}^{-1}$ . Lines corresponding to the stronger of these have already been observed in the Raman spectra of  $\text{CO}_2$  and  $\text{HCN}$  precisely at the positions indicated by the infra-red observations.

E F BARKER

University of Michigan,  
Nov 30

<sup>1</sup> *Proc. Roy. Soc. A*, **128**, 204, 1930

<sup>2</sup> *Physical Review*, **38**, 1827, 1931

<sup>3</sup> *Rev. Mod. Phys.*, **3**, 280, 1931

<sup>4</sup> *Z. Physik*, **70**, 84, 1931

<sup>5</sup> *NATURE*, **127**, 817, 1931

### Selective Action of Living Tissue to Homogeneous Radiation

A SELECTIVE action has been observed<sup>1</sup> when the allantoic membrane of the embryo chick is exposed to homogeneous X-radiation obtained by crystal diffraction.

The biological response, depicted in Fig 1, A, may be described in terms of a series of maxima connected by an empirical formula  $\lambda = kn^2$ , where  $\lambda$  is expressed in cm,  $k$  is a constant equal to  $3.2 \times 10^{-10}$ ,

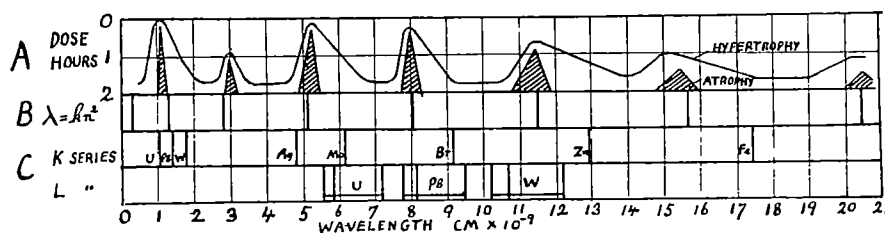


FIG 1

and  $n$  is given successive integral values from 2 to 8 (Fig 1, B)

A 'maximum' is predicted at a wave-length of  $3.2 \times 10^{-10}\text{ cm}$  by making  $n$  equal to 1, but unfortunately the experimental investigation would be very difficult.

The position of a 'biological maximum' is only known within a margin of  $\pm 0.25 \times 10^{-9}\text{ cm}$ , owing to the use of comparatively wide spectrometer slits, and the experimental evidence is somewhat scanty for high and low values of  $n$ . Nevertheless, there are great difficulties in associating the selective action with the K and L levels of heavy atoms, some of which are present in minute quantities (Fig 1, C) (Tungsten, silver, and bromine are not present, but of importance in energy measurement).

The suggestion is made that the above formula might be associated with a series of nuclear energy levels in one of the light atoms which form the main bulk of living tissues.

W MOPPETT

The University of Sydney,  
Oct 12

<sup>1</sup> Moppett, *Proc. Roy. Soc. B*, **105**, p 402

### Effect of Light on the Surface Tension of Boys's Soap Solution

IN his letter in *NATURE*,<sup>1</sup> Dr P. Lecomte du Nouy says "As the concentration of the soap solution + glycerin which he [L. D. Mahajan<sup>2</sup>] uses is not stated, but may be as high as 2.5 per cent—which should give a very small drop—it is indeed quite possible that illumination plays a part in this case."

Dr du Nouy and others who are interested in the subject may be interested to know that I used Boys's soap solution and its various dilutions—even up to one per cent of the Boys's soap solution in the dilution. The minimum strength of the sodium oleate in the dilution which I studied was  $2.5 \times 10^{-4}$ . In all observations the results obtained were found constant throughout for all dilutions. The details of the above work<sup>3</sup> are published in the *Indian Journal of Physics*.

I am now trying still higher dilutions, even up to  $10^{-8}$ . The results are appearing hopeful again, and interesting, and will shortly be published.

L D MAHAJAN

Physics Laboratory, Mohindra College,  
Patiala, India, Nov 20

<sup>1</sup> P. L. du Nouy, *NATURE*, Oct 17, 1931, p 674

<sup>2</sup> L. D. Mahajan, *NATURE*, Sept 19, 1931, p 496

<sup>3</sup> L. D. Mahajan, *Indian J. Phys.*, Calcutta, vol 6, part II, pp 147-153

### An Agricultural Pamphlet.

IN 1905, Wilfarth, Romer, and Wimmer published in the *Landw. Versuchs. Stat.*, vol 63, a paper, "Über die Nährstoffaufnahme der Pflanzen in verschiedenen Zeiten ihres Wachstums." The importance of this paper in agricultural science was soon recognised, and before long an English translation was published in pamphlet form. Copies of this were obtained by the libraries at Rothamsted and at the Ministry of Agriculture, but not apparently by the British Museum or the Science Library.

The Rothamsted copy was obtained in the days when our library was not properly constituted, we had only very few books and no librarian, and we did not take the full bibliographical details. Our copy has long been missing, and on inquiry at the library of the Ministry of Agriculture we find that by a strange coincidence theirs also cannot be found, so that we know neither the translator nor the publisher, and consequently cannot take steps to obtain a new copy.

I should be grateful for bibliographical information, or, better still, to learn where I can now obtain another copy.

E J RUSSELL

Rothamsted Experimental Station,  
Harpenden, Herts,  
Dec 21

## Research Items.

**Eyebrows and Eyelashes in Man**—A preliminary report on a study of the eyebrows and eyelashes in man, a subject not hitherto treated in anthropological literature, is published by Prof V Suk and Dr F Rozprým in *Pub* No 142 of the Faculty of Science of the Masaryk University, Brno. The study deals specifically with form and colour and the question of heredity. Eyebrows are divided into 11 types according to form, which varies extensively. Of 470 cases the greatest number are classified as 'spreading', those which are evenly formed on each side occurring much more rarely, 96 cases of the latter as against 157 of the former. The 'even' occurs 20 times as frequently in women. 'Peaked', rising in the middle, is rare, occurring 12 times only. 'Narrowing', in which the eyebrows are thick at the medial end and narrow towards the distal side, seems to be a feminine form, occurring three times as often in women. A whorl running outward from the nose is also feminine. There is no correlation between form and colour. In the eyelashes the upper are more characteristic than the lower. The long curved eyelashes occur 150 times in a total of 470, being present twice as often in children under sixteen years of age. It is an infantile form, for this type of eyelash is shed at puberty and often replaced by a different type. It is generally dark brown to black. Short and straight occur equally often in men and women, but never in childhood. Short-curved is least represented, and occurs most frequently in men, never in children. Two apparently abnormal types were observed, one bent inward toward the eye, the other long and straight but hooked at the end. Inheritance of these characters having been neglected, there are no data for comparison, but one family tree shows interesting characters. Form and colour are not inherited together, but the inheritance of form is clearly to be seen.

**Black Disease and Sheep**—Pamphlet 19 of the Australian Council for Scientific and Industrial Research contains a concise account by Dr A W Turner of the nature and means of prevention of the much-dreaded black disease of sheep (infectious necrotic hepatitis). As a result of extensive investigations carried out by the Council and partly financed by the graziers themselves, it has been shown that this disease, which is responsible for such heavy losses in Australia, is largely preventable. An effective, but not costly, vaccine has been developed. This alone, however, will not prevent the incidence of the disease, for, as had already been suspected, the attack is dependent on previous injury caused by the liver fluke. The fundamental problem is, therefore, the elimination of this latter pest from Australia, and details of suitable methods for getting rid of fluke, such as drainage, treatment of marshy ground with copper sulphate, and drenching sheep with a mixture of carbon tetrachloride and liquid paraffin are described. Vaccination of sheep with the appropriate anti-black disease vaccine is also advised, and the necessity for burning infected carcasses strongly advocated. The cost of these operations is not prohibitive. Apart from labour, drenching and vaccinating sheep amounts to little over 2½d per sheep per annum, and considering the economic significance of the disease the outlay would seem more than justifiable.

**Power of the Adductor Muscle of Bivalves**—The power of the adductor muscle of the larger bivalves has often been remarked. Darwin referred to it in the case of the tropical *Tridacna*, and Vaillant in

1865 found that the absolute power of the adductor of *Tridacna elongata* ranged from 4919 gm to 7200 gm. per sq cm of section area of the muscle. Tadashi Tamura has now tested the power of the adductor muscle of thirty species of tropical marine bivalves, and has found it to range from 1071 gm in *Corallophaga* to 11,381 gm in *Chama* per sq cm of section area (*Science Reports, Tōhoku Imp Univ*, vol 4, Sept 1931). A comparison of the power of the adductor among different species of bivalves shows that the specific difference amongst lamellibranchs is far greater than in any other phylum of animals where such differences have been studied.

**Chromosomes of an Unfixable Dwarf Wheat**—In 1902 the late M Philippe de Vilmorin found two dwarf types in commercial wheats, but was unable to fix them by inbreeding, as the descendants always gave some tall progeny which bred true. Engledow and Wadham studied the problem and suspected chromosome irregularity. The solution has now been reached by Prof C L Huskins (*Jour Genetics*, vol 25, No 1), who investigated plants grown at Merton from seeds of Prof Engledow. It is shown that the dwarf plants in this unfixable wheat produce three main types of progeny: normals, dwarfs, and pigmies. The first two occur in ratio approaching 1:1, while the pigmies are rare. The tall have 42 chromosomes, the dwarfs 43, and the pigmies 44. In the dwarfs the extra chromosome is usually included in a trivalent in the pollen mother cell during meiosis, but is sometimes by itself or may form part of a quadrivalent or quinquevalent combination. Quadrivalents also frequently occur in the tall segregates. The extra chromosome in a dwarf is sometimes a long one and sometimes short, and the redistribution of these chromosomes produces smaller variations (noted by Engledow and Wadham) within the three main types which are due to the chromosome numbers. The main results are therefore similar to those obtained in the analysis of speltoid wheats and fatuoid oats.

**Germination of Teak**—Mr H R Blanford, of the Burma Forest Service, has paid a great deal of attention to the questions of germination, sowing, and planting of teak and other species. One of his latest papers on this subject is entitled "Experiments in Connection with Sowing and Planting Teak in Taungya Plantations" (*Burma For Bull* No 24, Silv Ser No 14, 1931) and is of very considerable interest. The paper deals with nursery experiments with teak seed, under the heads—treatment of seed and preparation of soil—position of nurseries—size of teak seed, direct sowing and transplanting of teak, and transplanting with stumps. Owing to the cheapness of seed in Burma in the past they have been content with a comparatively low germination percentage, but the importance of securing early germination would seem to justify extra treatment. It appears to have been finally established that it is moisture and not heat that is required for teak seeds sown during the hot weather. There does not seem to be much difference in seedlings originating from small and large seed, so that there is no reason for sifting the seed. Some valuable information has been obtained on the question of the comparison of the different methods of direct sowing and transplanting in a taungya plantation. The experiments apparently strongly confirm the very great advantage of planting as against direct sowing. The work carried out with teak stumps has not as yet reached a conclusive stage.

**Pliocene and Pleistocene Mollusca of California**—The main part of a "Catalogue of the Marine Pliocene and Pleistocene Mollusca of California and adjacent Regions", by U S Grant and H D Gale (*Mem San Diego Soc Nat Hist*, 1, 1931, pp 1036, pls 32), consists of a monograph of the species of Mollusca, but is preceded by a summary of the stratigraphy. It is pointed out that correlation by means of the percentage of extinct species may lead to erroneous conclusions. Thus some of the cold-water horizons seemed to be older than they really are, because of the apparently large proportion of extinct species, but with the fuller knowledge of northern faunas now available this percentage is known to be too high. It follows that faunas which lived under climatic conditions similar to those now existing in the neighbourhood will give the impression of being more like living faunas than those which lived during colder periods. Climatic changes are a fundamental cause of differences in faunas, and it is believed that these changes were widespread, especially in Pleistocene times, and are therefore of value in correlation over wide areas. The number of extinct species in the Californian Pliocene is already known to be much less than half the total number of species, and, when the living faunas of western Mexico and central America are better known, the number is likely to be further reduced. A number of striking similarities between Californian species and corresponding forms in Japan, the eastern United States, Europe, and Africa have been noticed. In California there appears to have been one well-marked sedimentary cycle in the Miocene and another in the Pliocene, and the beginnings and endings of these seem to have coincided with the beginnings and endings of the Miocene and Pliocene periods in Europe. It is believed that California remained relatively stable during the Miocene and Pliocene periods, and that the only widespread deformation that would upset the orderly sequence of sedimentary cycles did not come until the middle of the Pleistocene.

**Giant Pleochroic Haloes**—In 1920 Hirschi discovered abnormally large pleochroic haloes in the biotite of an Alpine syenite (radii, 54  $\mu$ ). Ten years later Wiman recorded the presence of similar haloes (55-60  $\mu$ ) in the biotite and hornblende of the Pre-Cambrian granites near Uppsala. As such haloes have not been generally observed, Wiman thought it improbable that they could be ascribed to the action of the long-range  $\alpha$ -particles from radium-C or thorium-C. See "The Age of the Earth", *National Research Council Bull.*, 80, p 187. It now appears from an examination of similar giant haloes in cordierite-gneiss from Madura, South India, that the hypothesis rejected by Wiman may, nevertheless, provide an explanation. At the eighteenth Indian Science Congress (*Proceedings*, p 309) M S Krishnan and C Mahadeven claimed to have shown conclusively that the dimensions of the giant haloes in cordierite correspond to the ranges 9.3 cm for radium-C and 11.5 cm for thorium-C in air. The full development and excellent state of preservation of the structures in these haloes is ascribed to the richness of the cordierite in radioactive nuclei-minerals and the long period of activity of the latter. The gneiss dates from early Pre-Cambrian times. The intensity of pleochroism in the haloes varies with the directions of light absorption in the cordierite.

**Auroral Heights in Canada**—The *Canadian Journal of Research*, vol 5, Sept 1931, pp 285-296, contains an important article on auroræ by J C McLennan, H S Wynne-Edwards, and H J C Ireton. On four dates in January and February 1931, photographs of auroræ (mainly of arc or band type)

were taken simultaneously from two stations, 46 km apart, alongside the Temiskaming and Northern Ontario Railway, the telephone system of which was made available to the observers. The main station (Onakawana) was at lat 51° N, long 81° W. A Kioogness auroral camera was used. The heights found ranged from 70 km to 130 km, the height of most frequent occurrence being about 95 km. These are a few kilometres lower than the corresponding heights found by Størmer in Norway. The geographical situation of the auroræ is shown on a map; the arcs and bands lie, as elsewhere, roughly at right angles to the magnetic meridians. The paper is enriched by beautiful reproductions of twelve pairs of auroral photographs.

**Correlation of Pressure and Temperature in the Upper Atmosphere**—The exploration of the upper atmosphere by means of sounding balloons equipped with apparatus for measuring pressure, temperature, and sometimes humidity, has been pursued to an increasing extent during the past twenty years, in the hope that this may lead to an understanding of the causes of the cyclones and anticyclones that are of such importance in governing the day to day variations of the weather. In Great Britain W H Dines showed that there is high positive correlation between pressure and temperature at any level between about 2 km and 8 km. W Van Bemmelen found a somewhat similar relationship for the upper atmosphere over Java, the principal difference being that the largest coefficients found there were not so large as those found for the British Isles, while they occurred higher up, between heights of about 8 km and 16 km. S Gopal Rao has now given an analysis of 185 soundings made at Agra in 1925-29, and compared the results with those obtained by Dines and Van Bemmelen (India Meteorological Department, *Scientific Notes*, vol 3, No 26, March 1931). He divides the material into two parts—winter and summer monsoon. The correlation coefficients for winter show a variation with height that agrees more nearly with the results of Dines, with the difference that the positive correlation disappears at 13 km instead of 11 km. The variation of those for the summer monsoon, on the other hand, agrees fairly well with that for Java. It appears that adjustment to conditions normal for a given latitude takes considerable time, considering that when the air supply to India is tropical, as happens at the height of the summer monsoon, conditions are found there such as are normal to a place near the equator. The gradual extension of such statistical inquiries to new regions is obviously desirable, and it is greatly to be hoped that the forthcoming Polar Year of arctic research may result in high latitudes receiving attention.

**Fundamental Physical Constants**—In two recent papers in the *Philosophical Magazine*, Dr W N Bond has developed a new way for reducing the experimental data used in connexion with determinations of the electronic charge ( $e$ ) and Planck's constant ( $h$ ), based on the observation that each group of experiments connects  $h$  and  $e$  by an equation of the form  $h = Ae^n$ , where  $n$  is either 1,  $1\frac{1}{2}$  or  $1\frac{2}{3}$ , according to the experiments, and  $A$  expresses the results of the measurements made. By taking two types of experiments with different values of  $n$ ,  $e$  and  $h$  may be found with previously unattained precision. By this method Dr Bond showed that Eddington's constant had a value of  $137.02 \pm 0.06$ , in excellent agreement with theory. The subject has now been taken up again by R T Birge, and in a note appearing in the *Bulletin of the American Physical Society* for Dec 6 he expresses the opinion that Bond's method

for evaluation of  $e$  is far more reliable than any direct determination, but disagrees with the way in which it has been followed up. In Birge's new calculation by Bond's method, the values of  $e$  and  $h$  are found to depend chiefly upon the value adopted for the specific charge ( $e/m$ ) of the electron, which he takes to be  $1.761 \times 10^7$ , remarking that this now seems well-established. It leads to a value of  $137.28 \pm 0.07$  for Eddington's constant, whereas if this were 137 exactly,  $e/m$  would have a value which he regards as improbably high.

**Constant Monochromatic Spark Illumination**—Forbes and Brackett, in the November *Journal of the American Chemical Society*, describe an apparatus by means of which a spark between metal electrodes can be maintained automatically constant over fairly long periods. The spark is struck between adjacent edges of two square bars moving in horizontal planes at right angles to each other, the bars being retracted by threaded rods passing through sleeves rotated by worm gears. In the case of zinc bars 400 mm long and 25 mm square, a life of one and a half hours per pair of edges was obtained with a 5 kw transformer operated on 35 amp and 110 volts. Measurements showing the constancy of the energy of emission from a monochromator for various metal electrodes are given, and also a simplified method of following the energy of emission through a measurement.

**Thermodynamics of Gas Reactions**—H. Scheibel, in the *Sitzungsberichte der Vienna Academy of Sciences*, Abt. IIb, vol. 140, p. 183, discusses in detail the calculation of gaseous equilibria by means of three types of formula: (1) the classical formula, with observed values of specific heats, (2) the formula making use of Nernst's chemical constants, and (3) the formula using the specific heats calculated by the quantum theory from the results of band spectra. The results show that the first type of formula gives the most reliable values, although it is based on

empirical results. The other two formulae, although they have a theoretical basis, involve so many approximations and (in the third case) uncertainties that it is not surprising that they do not, in general, show very good agreement with experiment. In the case of complicated molecules, for example, there is doubt as to the number of degrees of freedom involved and the extension of the Planck-Einstein function deduced for monatomic solids, to gases is not strictly justified by theory. It is to be expected that further experimental investigation will lead to improvement in this respect, when the third formula will probably be the only one in general use.

**Freezing Point of Platinum**—*Research Paper No. 326* of the U.S. Bureau of Standards, by Roeser, Caldwell, and Wensel, deals with the freezing point of platinum on the International Temperature Scale, measurements being made of the ratio of brightness of black bodies maintained at the freezing points of gold and platinum, the black bodies consisting of hollow enclosures of fused thorium oxide immersed in the fused metals. The metals were heated in air in a high frequency induction furnace to secure automatic stirring of the freezing metals and to avoid contamination from furnace windings. The International Temperature Scale adopted in 1927 by the General Conference of Weights and Measures defines temperatures above the freezing point of gold in terms of Wien's law of radiation, and the method adopted was therefore one which permitted direct reference to this scale. The mean value of the freezing point of platinum, obtained with two lots of pure platinum, two optical pyrometers and observations by three observers, was  $1773.5^\circ \text{C}$ . Other recent measurements when reduced to the International Scale, are  $1769.5^\circ$  by Hoffmann in 1924, and  $1762^\circ$  by Ribaud and Mohr. The paper also contains a list of fourteen previous independent determinations of the melting point of platinum.

### Astronomical Topics.

**Eclipse of the Moon of Sept. 26, 1931**—*L'Astronomie* for November contains a series of photographs of the partially eclipsed moon, also diagrams by M. Ananoff showing the distribution of colours on the lunar disc during the total phase. The most interesting point is that there was a region described as "Bleu-verdâtre" throughout totality, though it changed its position on the disc. Blue is not very often seen on the moon (witness the phrase 'once in a blue moon'), but the writer of this note recorded that part of the disc was of a decided blue colour in the eclipse of Oct. 17, 1902. Dawn ensued shortly after this, and it was of a pure blue colour, without any admixture of red, this probably had some connexion with the blue on the moon. A note, with a diagram, was published in *Observatory* for November 1902.

**Astronomical Society of South Africa**—Vol. 3, No. 1, of the *Journal* of this Society begins with a well-deserved eulogy of Rev. Fearon Fallows, the first director of the Cape Observatory, who died in 1831, aged forty-two years. His death was hastened by overwork and anxiety. In spite of grave difficulties, due to inadequate assistance and unsatisfactory instruments, he made a creditable beginning in the work for which the observatory has since become so famous, his wife took observations with the mural circle, since he was deprived of an assistant. This circle had been sent out to him in an unfinished condition, the steel collar not having been properly

attached. The article closes with the words: "May a long succession of His Majesty's Astronomers, and the people of South Africa, never forget how much they owe to the patient, self-sacrificing, and arduous labours of Rev. Fearon Fallows." An account follows of a large meteor seen to fall in 1838, the explosion being heard over a radius of 70 miles. A number of fragments were collected, some weighing 3-4 lb. This meteor is omitted from many lists of meteors seen to fall.

Four photographs of the total lunar eclipse of April 2, 1931, are reproduced. The gradation of shading at the edge of the shadow is well brought out. The fourth picture was taken during totality with exposure only two seconds, the limb is clearly visible, and some trace can be seen of the maria. The report of the comet section notes that this is the first report since 1916 that does not include the discovery of a comet in South Africa. Mr. Blathway spent 130 hours in searching for comets, but without success. A very complete series of observations of Encke's comet was made at Johannesburg.

Nova Pictoris is fading very slowly, and is still of magnitude 8.4. The light of the central star is nearly constant, but the components *B* and *C* are fading. Dr. Spencer Jones reports that the spectrum is of Wolf-Rayet type, but with a strong emission of unknown origin at 6087 Å. His conclusions as to the present condition of the star were communicated to the Royal Astronomical Society, and have already been noted in this column.

## Early Scientific Worthies of America

IN 1661, John Winthrop, son of John Winthrop the first governor of Massachusetts, visited England for the purpose of securing from Charles II a royal charter for Connecticut, of which colony he had himself for many years held the governorship. Born in 1606, he had travelled, and studied, was a capable physician, possessed a knowledge of chemistry and metallurgy, and had promoted the iron and other industries of the American colonies. Twice before he had visited England, but his third visit coinciding with the birth of the Royal Society, at a meeting of the Society in the old Gresham College in December 1661 he was chosen one of the members, and in May 1663, after the Society had secured its charter, his name was included in the list of original fellows.

Already known to many European men of science, after his return home Winthrop became the western correspondent of the Royal Society, and it was mainly through his letters from Newton, Boyle, Hooke, Barrow, and others, and the *Transactions* of the Society that the mathematicians and naturalists in the colonies learnt of the progress of science in Europe. Winthrop's active and useful life came to a close on April 5, 1676, and he was buried in King's Chapel, Boston, where his famous father and some of his distinguished descendants also lie.

Such, briefly, is the biography of the earliest of the scientific worthies of America, to whom Mr F E Brasch refers in two historical articles on the Royal Society of London and its influence upon scientific thought in the American colonies, published in the *Scientific Monthly* for October and November. When Winthrop lived, the colonies were still but sparsely populated, and the conditions of life could have provided little opportunity for the pursuit of knowledge for its own sake. Yet long before he died Harvard College was a flourishing institution, and, as Mr Brasch shows, with the growth of the college, the effects of the intercourse between the Royal Society and America, which began with Winthrop, were more and more fully felt, with advantage to both the Society and the colonies. To this intercourse may be traced, among other things, the founding of both the American Philosophical Society and the American Academy of Arts and Sciences.

Mr Brasch's review covers the latter half of the seventeenth and the whole of the eighteenth century, and in that period he recalls no fewer than eighteen

fellows of the Royal Society who were connected with American science in one way or another. Among these were Thomas Brattle, a successful merchant and treasurer of Harvard, whose astronomical observations of the comet of 1680 were of use to Newton and Halley, William Brattle, his brother, the first tutor of philosophy in the colonies, William Byrd, who sent plants and minerals to Sir Hans Sloane, John Leverett, president of Harvard, Cotton Mather, who corresponded with John Woodward and sent him fossils, Paul Dudley, Chief Justice of Massachusetts, who communicated to the Royal Society papers on natural history and is regarded as the first horticulturist in America, and John Winthrop (1681-1747), a diligent collector, to whom the fortieth volume of the *Transactions* of the Royal Society was dedicated.

Valuable as were the efforts of these individuals in furthering the claims and interests of science, of still greater importance was the work of Benjamin Franklin, John Winthrop (iv), Dr John Morgan, and David Rittenhouse, who were admitted to the Royal Society in the years 1756, 1766, 1765, and 1795 respectively. Franklin is rightly regarded as the foremost American man of science of the eighteenth century, and not the least of his services was the constant solicitude he showed when abroad for the reputation of his fellow-workers at home. He was "virtually the intellectual ambassador of his fellow-beings."

Mr Brasch calls John Winthrop (iv) the first real scientific astronomer and the first Newtonian disciple in America. Born in 1714, eight years after Franklin, Winthrop at the age of twenty-four years was chosen professor of mathematics and natural philosophy at Harvard, a post he held with distinction until his death in 1779. He introduced the study of fluxions, he established a laboratory for experimental physics, for more than thirty years he made astronomical observations, he contributed eleven papers to the Royal Society, and to him can be attributed the founding of the American Academy of Arts and Sciences.

Of John Morgan (1735-1789) it is sufficient to say that he was the founder of the first medical school in America, while David Rittenhouse (1732-1796), who as a boy drew mathematical figures on fences and barn-doors, planned the first observatory in the colony and was the successor of Franklin as president of the American Philosophical Society.

## The Physics Workshop at the Imperial College.

ON Wednesday, January 6, during the special session for members of the Annual Exhibition of the Physical and Optical Societies, Prof C V Boys, in the presence of about a hundred subscribers, presented Mr W J Colebrook, formerly superintendent of the physics workshop of the Imperial College of Science and Technology, with a cheque for £100 on the occasion of his retirement. Mr Colebrook had been connected with the workshop for forty years, and in addition he had acted during the War as workshop consultant to the War Office X-ray Committee, and from 1914 to the present time had been superintendent of the Air Ministry workshop. The testimonial represented the good wishes and appreciation of a large number of scientific workers.

During the course of an interesting address, extracts from which are subjoined, Prof Boys outlined the early history of the physics workshop, with which he himself had been closely associated, and described how he had 'discovered' Mr Colebrook

Lord Rayleigh, who occupied the chair, added that during the years in which he had worked at the Imperial College he had been impressed by the efficiency of Mr Colebrook's workmanship and his capacity for organising his department with a complete absence of friction and ostentation. Further appreciations were expressed by Lieut-Col K Edgecumbe and Mr Watson Baker, representing the British Electrical and Allied Manufacturers' Association and the British Optical Instruments Manufacturers' Association respectively, and the former presented Mr Colebrook with an additional cheque on behalf of fifty-seven exhibitors at the Annual Exhibition of the Physical and Optical Societies, of which he had been organiser during the twenty-one years since its establishment. Mr Colebrook, acknowledging the testimonials in an interesting and appropriate speech, expressed his gratitude for the invariably friendly relations which had always existed between him and those with whom he had worked.

In the course of his speech, Prof Boys said

"We have met to-day to express our appreciation of the valuable services which have been rendered by Mr Colebrook during the last forty years. During this time he has made us all his debtors on account of his industry, his good temper, his willingness and desire to help, and, above all, by his consummate skill as a craftsman.

"When I see now the magnificent collection of tools which in the present century has grown up under his guidance, and contrast it with the meagre equipment of my time, I feel that the early history of the workshop—which no one else but myself can give—and of the introduction of Mr Colebrook is of sufficient general interest for me to recount.

"About the year 1873, Prof Guthrie made out an order for a small general purpose lathe, but this order was stopped when it got to the museum, and the official answer, put colloquially, was—'Lathe? What can you possibly want with a lathe in a physical laboratory?' If you have anything which you want to be turned, let us have it and we will get it turned in the museum workshop.' Well, Prof Guthrie was Scotch and very persistent, and General Festing, R.E., the engineer in charge of the museum and workshops, was a delightful, genial, and jovial friend of all who came his way. The result was, skipping intermediate steps, that a little 4-inch Cotton and Johnson lathe was acquired, and, though a poor little thing, it was in constant use and proved itself invaluable.

"Coming now to the second chapter, about the year 1890, Prof Rucker and I felt that we must have something better, and it was left to me to select a suitable lathe, but with the strictest attention to cost. There was very little money, and we did not want to draw a second refusal similar to the first. I selected what I considered the best possible lathe for physical laboratory requirements that was not too expensive. This was the Barnes 5½-inch centre lathe, and after forty years I still consider that I

could not have done better. I got the identical lathe for myself a few years later, and this is all I have for my own use to the present day. It may be interesting to state that when Prof Mendenhall came to see me, he said—'Why, that is the lathe on which Rowland cut his famous screw—the screw of his diffraction grating machine.'

"Having now a suitable lathe, it was essential that there should be a skilled mechanic to use it and to protect it from misuse, and again I was asked to find him. I heard of Mr Colebrook, and got him to come for a preliminary discussion. I asked him to do something with the new lathe and with a file, and, being a bit of a mechanic myself, I saw with half an eye that his handling of these tools showed him to be a skilled craftsman.

"This was the time when I was preparing my apparatus for weighing the earth, which I did at Oxford. The main apparatus was made by the Cambridge Scientific Instrument Co., but much had to be done besides, and this construction was done partly by Colebrook (I must now drop the Mr) and partly by myself. It was then that I learned to appreciate not only Colebrook's skill but also his conscientious devotion to the work. About the same time I was photographing bullets, and I required a very perfect revolving mirror to analyse the sparks that I used in order to get one bright enough, small enough, and of short enough duration so that the bullet should not travel more than  $\frac{1}{16}$  inch while it was being photographed. I designed this to be made in dead-hard tool steel. Colebrook made it to perfection, and it was figured by Hilger. We ran this at 500 revolutions per second for ordinary use, but we did run it up to 1500 revolutions per second, at which it ran well. This is nearly twice the speed at which Foucault ran his mirror when determining the velocity of light, and my mirror would have shown the time taken by light to traverse the length of this lecture table. It was to Colebrook that I owed the success of this mirror."

### A New Method of Measuring High Frequency Voltages.

IN the *Elektrotechnische Zeitschrift* for Aug 13, L Pungs and H Vogler describe a new electro-optical method of measuring voltages of very high frequencies. In practice, some type of electrometer is generally employed, but with very high frequencies its readings are untrustworthy. The authors made a test on a good electrometer of a type usually employed, and found that up to one and a half million cycles per second it gave accurate and consistent results, but at twelve million cycles its readings were incorrect by errors lying between thirty and forty per cent. As these instruments are largely used in radio work for making investigations on the dielectric behaviour of insulating materials, it was necessary to find the cause of the inaccuracies and either correct their design or try to invent a new method. The errors of the instrument were found to be mainly due to the fact that its capacitance varied with its deflection, for this led to resonance effects which made the readings quite irregular.

The authors have found a practical solution applicable to many cases. They utilise the well-known Kerr effect in electro-optics, which has been studied carefully by many physicists. The physical basis of their method is to use a monochromatic source of light, a Nicol's prism as polariser, a cell containing nitrobenzene subjected to electric stress between two parallel metal plates, maintained at the voltage to be measured, and a second Nicol's prism as analyser. The field of view is first extinguished by crossing the prisms when the voltage is not applied. On applying

the voltage, light comes through owing to the Kerr effect. If the voltage be alternating, the intensity of the light is a periodic function of the time.

The authors obtain a mathematical formula for the mean intensity of the light passing through, showing that, on the supposition that there is no inertia effect, it is independent of the frequency of the alternating voltage. Making sine wave assumptions also, they prove that it is proportional to the maximum value of the electrostatic field. With the help of tables of Bessel's functions they calculate the maximum voltage, which can be found in terms of the mean light intensity. Since the mean light intensity is independent of the frequency, the instrument can be calibrated with low frequency voltage.

The main difficulties that had to be overcome in connexion with the method are, first, that the Kerr constant varies very appreciably with temperature. Hence unless the temperature remains constant it has to be measured and a correction applied. The calibration also depends on the intensity of the source of light, it is therefore necessary to specify accurately the source of the light. The calibration is only accurate for light of a definite wave-length. The authors, therefore, were led to develop a comparison method which enables a higher accuracy to be obtained.

In this method the Kerr arrangement is adjusted so that the field is dark with zero voltage, a photoelectric cell being employed. The voltage is then applied to the Kerr cell, and the illumination of a second photoelectric cell is adjusted to a balance by



means of an electric circuit. The high frequency voltage is then cut out and a fifty cycle voltage applied, and the electric circuit is adjusted until the balance is the same as before. In this way the effective value of the high frequency voltage can be found. The comparisons are made rapidly, so that the temperature of the Kerr cell remains practically constant and the necessity of applying a temperature correction is eliminated. So long as the colour of the light is the same when making the two comparisons, it is not necessary to know its wave-length.

According to results obtained by physicists, it can be assumed that up to frequencies of thirty million cycles per second the Kerr effect is free from inertia.

In this case the wave-length is ten metres. The authors suggest that it can probably be used down to five metre wave-lengths. They have used the method for voltages lying between 300 and 4000 volts. The highest frequency they used was twelve million cycles (25 metres). By using a Pulfrich photometer and applying a direct method they found that the error was 1 per cent when the applied voltage was 800 and 0.33 per cent at 1800 volts. With the photoelectric method the error was 2 per cent at 800 volts and 0.1 per cent at 1800 volts. This method has the disadvantage that the photoelectric cells and the amplifying apparatus have to be carefully screened.

### Annual Conference of the Geographical Association

THE Annual Conference of the Geographical Association was held at the London School of Economics, by kind permission of the director, Sir William Beveridge, on Jan 6-8. As usual, the Conference was well attended by delegates and members from all parts of Great Britain, and at some of the lectures the audience exceeded four hundred. A representative publishers' exhibition, in which twenty-six firms took part, was held in conjunction with the Conference. At the termination of the proceedings in London, according to established custom, a party of members spent the week-end in a country town, this year at Rochester.

Of outstanding importance was the presidential address by Sir Leslie Mackenzie, entitled "A Health Administrator's Attitude to Geography." The work of the medical profession deals increasingly with the prevention of disease as opposed to the cure of disease, and for the medical officer of health geography must be his guide, for geography is the study of the earth as the environment of man, and Sir Leslie referred to the "flowingly intimate" correlation between health conditions and geography. In Scotland the three million population of the Midland Valley contrasts with the 420,000 people of the Highlands—a reflection of relatively favourable and relatively unfavourable geographical conditions. A study of malnutrition amongst Highland school-children has shown an intimate connexion with bad harvests, which in turn reflect fluctuations in climatic conditions from year to year in a region where other geographical factors such as physiography and soil exercise a somewhat rigid control.

Coming to details, Sir Leslie pointed out that geographers have long emphasised the importance of aspect in influencing the distribution of natural vegetation and crops. It is equally important in determining health conditions. There are valley sides "half starved of sun for a million years" which must inevitably remain disease traps for their human inhabitants when compared with the opposite slopes of the same valleys. Further reference was made to the geographical methods of mapping distributions and of determining limiting factors in each case. There is need for the health administrator to follow these methods. What, for example, is the limit of distribution of tetanus in the soil of France? Is it coextensive with a certain type or certain types of soil? The widespread distribution of tetanus in Flanders soil was one of the great problems which had to be tackled by the medical service during the War. Modern developments, for example, in the field of transport must not be ignored by the medical officer, it has been shown, for example, that disease-bearing mosquitoes can be carried 12,000 miles by aeroplane. In short, the work of the health officer

provides a new *motif* for the study of geography and the employ of cartographical methods of studying distributions.

The work of the Conference included also an important joint discussion with the Historical Association on "What is Historical Geography?" Prof. C. B. Fawcett undoubtedly stated the main difficulty when he said that there are so few equipped with an adequate training in both geography and history, and that until students so equipped are forthcoming the present confusion is likely to continue. He referred to Sir Halford Mackinder as a historian who has become a great geographer, and has expressed the relationship between the two sciences by saying that every event occurs both in space and time and is thus the concern both of geographer and historian, though, of course, not all events are of equal importance to either student.

The discussion made it clear that many of the historians present were inclined to equate 'geography' to 'physical geography' and failed to appreciate the modern human geography. Thus, Dr J. E. Morris stated "A geographer can only introduce the subject, for, when he has told us all about climate and situation, environment and stimulus, geological conditions and rainfall, it remains for the historian to show how men have used their opportunities." There was clearly no appreciation of geographical synthesis, of the study of the environment as a living concrete whole, continually acting and reacting on the central figure of man. Similarly, Prof. F. S. Marvin referred to the natural factors, "the river, the mountain, or the sea", and was obviously limiting his conception to the factors of physical geography. On the other hand, Prof. A. P. Newton showed clearly that he represents a school of historians having a clear conception of the methods and value of modern geography. Prof. E. G. R. Taylor showed how a descriptive topographical introduction accompanying historical works has come to receive the label 'historical geography' for what should be merely the geography of history. Indeed, the whole discussion made it clear that both geographers and historians have been guilty of selfishness: geographers using some of the results of historians to further geographical knowledge, historians using fragments of geography here and there for the advancement of historical studies. A plea was made whereby the Geographical and Historical Associations might devise some scheme for the exchange of research data. Miss Jeffries Davis, editor of *History*, surprised many of her listeners by finding a common requirement of both historians and geographers outside the direct sphere of either—the early completion of the 'drift' edition of the geological maps of Britain.

Dr Gerhard Schott, the well-known oceanographer

of Hamburg, was the Association's principal foreign guest this year, and gave a lecture on the "Humboldt Current in relation to Land and Sea Conditions on the Peruvian Coast." Dr H R Ormsby lectured on the part played by the limestones in the human geography of France, and afforded thereby a delightful example of the broader conceptions which can be drawn from a study of the detail accumulated in her recent book on "France."

At the annual general meeting, Dr L Dudley Stamp reported on the progress of the Land Utilisation Survey of Britain, and referred to the urgent necessity of completing the Survey in the present year, so that the record for the whole country would be for 1931-32. He asked especially for volunteers (to communicate with him at the London School of Economics) to complete areas in Oxfordshire, Huntingdon, West Suffolk, Essex, West Sussex, the Isle of Wight, Gloucester, Leicester, and North Yorkshire.

Brigadier H S L Winterbotham gave the Association an account of new developments in the Ordnance Survey one-inch maps. Mr S A S Hozayen lectured on the Arab geographers, Mr J Fairgrieve dealt with several aspects of the cinema in schools, and the Association welcomed an old friend in Prof P F Kendall.

L DUDLEY STAMP

### University and Educational Intelligence.

CAMBRIDGE.—It is announced that Mr R H Fowler, fellow of Trinity College, and University lecturer in mathematics, has been appointed to the John Humphrey Plummer professorship of mathematical physics. Prof Fowler is distinguished for his theoretical investigations of the structure of the atom and related subjects.

LEEDS.—The University has received the legacy of £100,000 bequeathed to it for general purposes by the late Lord Brotherton. In conveying thanks to the executors for making the presentation in person and for their expressions of goodwill towards the University, the chairman of the Finance Committee stated that Lord Brotherton, during his lifetime, made gifts to the University amounting to £120,150, chief amongst which were £20,000 for the endowment of the chair of bacteriology and £100,000 for the building of a new library. The erection of the latter—to be known as "The Brotherton Library"—will be commenced shortly, the foundation stone already having been laid by Lord Brotherton himself.

Mr T H Blakeley has been elected to the Gas Research Fellowship endowed by the Institution of Gas Engineers, which has been rendered vacant by the appointment of the previous holder, Dr A H Eastwood, to the staff of the Joint Research Committee of the Institution and the University. Mr Blakeley has carried out an investigation into the thermal conductivity of materials used for the insulation of high temperature furnaces. As holder of the fellowship, he will undertake further research work in the University under the direction of the Livesey professor of coal gas and fuel industries, on the reactivities of carbonised fuels at high temperatures.

Two special lectures of the series dealing with aspects of biochemistry being given at the Chelsea Polytechnic, Manresa Road, London, S W 3, will be delivered by Dr Colin H Lea, of the Low Temperature Station, Cambridge, on Jan 28 and Feb 4, at 6 p.m. The subject of Dr Lea's lectures will be "Some Recent Advances in the Chemistry of the Fats." Further particulars can be obtained from the principal of the College.

TECHNICAL Colleges in Great Britain differ noticeably from one another in respect of their devices for maintaining close touch with the changing needs of the various industries which look to them for recruits or for the further education of persons already in employment. This remark is prompted by an inspection of a number of prospectuses for the current session. The Heriot-Watt College, Edinburgh, is conspicuous for the completeness of its system of associating itself with industrial firms. On its board of governors are representatives of printing and kindred trades and engineering employers' associations, coal owners and miners and building trades associations, local trade unions and the fermentation and pharmaceutical industries, and it has advisory committees for the printing trades (8), central mine-rescue station, engineering, mining, building, pharmacy, commercial studies, and stock exchange. The Royal Technical College, Glasgow, has on its committee on chemistry and metallurgy representatives of four firms and the president of the West of Scotland Iron and Steel Institute, and has representatives of firms or industrial associations on committees on engineering, textiles, building, navigation, pharmacy, bakery, and watch- and clock-making. The Technical College, Bradford, has on its college committee the presidents of the Chamber of Commerce and of the Trades and Labour Council. The Manchester Municipal College of Technology has sectional committees for textile industries, pure and applied chemistry, engineering and handicrafts and an advisory committee on industrial administration. Unfortunately, many prospectuses give no indication of the existence of any systematic check being applied to the tendency commonly to be found in teaching institutions in Great Britain to become too academic and out of contact with our industries.

### Calendar of Geographical Exploration.

Jan 24, 1616—Le Maire Strait

Two Dutch navigators, Willem C Schouten and Jacob le Maire, discovered the strait between Tierra del Fuego and Staten Island. They had sailed from the Texel on June 14, 1615, hoping to discover a passage to the South Sea south of Magellan Strait, since only members of the Dutch East India Company might sail either by the Cape route or Magellan's Strait. On Jan 29 the vessels were off Cape Horn, the southernmost point of the Tierra del Fuego Archipelago, which received its name from Schouten's birthplace, Hoorn. On their journey across the Pacific they discovered Dog Island, in the Low Archipelago, and Boscawen and Keppel Islands, between the Fiji, Tonga, and Samoan groups. They then touched the hitherto unvisited coast of New Ireland. They had hoped to reach the supposed southern continent, and made a survey of the north coast of New Guinea, thinking that this island might be part of Terra Australis. At Java their vessel was confiscated because it was thought that they must have used one of the forbidden routes. They were sent home on another vessel, Le Maire dying on the voyage home. His father, after two years' effort, secured recognition of the fact that a new strait, south of Magellan's, had been discovered.

Jan 26, 1621—The Gambia

Richard Jobson left Tenda, after having sailed up the Gambia river. There he had heard stories of a city in the interior the roofs of which were covered with gold. He concluded that this was Timbuctoo, but that city was really 1000 miles from Tenda.

Owing to the shallowing of the river when the dry season set in, Jobson was compelled to start his return journey on Feb. 10, and not for a century was any further effort made to reach the Niger river and inner Africa. Jobson had been sent out by a company formed in Britain in 1618 with the purpose of exploring the Gambia. Their first expedition was entrusted to Richard Thompson, the pioneer of British exploration in Africa. But attacks by the Portuguese, mutiny among his own followers, and the deadly climate resulted in failure, Thompson being murdered by his own men. Jobson escaped with his life, but the company was dissolved.

Jan. 26, 1903—Coats Land and the Weddell Sea

W. S. Bruce in the *Scotia* left Port Stanley, in the Falklands, on a voyage to the Weddell Sea for purposes of scientific examination, Dr. R. N. Rudmose Brown and other scientific workers accompanying him. The vessel was anchored off Laurie Island for the winter, and scientific work and sledge exploration were carried on. In November 1903 the *Scotia* left Laurie Island, the meteorologist of the party, Mossman, remaining behind with five companions. The *Scotia* proceeded to Buenos Aires and brought back a party of Argentine meteorologists, who remained with Mossman on Laurie Island, while the vessel steamed southwards, discovering Coats Land and reaching 74° 1' S in 22° W. The *Scotia* carried a line of deep soundings across a vast stretch of previously uncharted ocean, and corrected Ross's marking of a point "4000 fathoms, no bottom", to 2660 fathoms, the powerful undercurrent and the less perfected instruments of Ross having caused the error.

## Societies and Academies.

### DUBLIN

Royal Irish Academy, Dec. 14—J. M. O'Connor. The nature of the metabolic regulation of the body temperature, and its relation to temperature sensations. The oxygen consumption of rabbits under urethane anaesthesia in relation to the rectal, brain, and mean skin temperature is analysed statistically. When the animal is not shivering, the oxygen consumption as determined in short periods (about 6 minutes) is closely correlated with the rectal temperature and is not appreciably influenced by the dose of anaesthetic used. The results obtained coincide with values previously established under the influence of curare. When the animal is shivering, there is an additional consumption of oxygen, which rises as the skin temperature falls from 35° C to 28° C, after which it declines and disappears at a skin temperature of about 23°. These short period results were confirmed by the examination of 40-minute periods during which the animals' temperatures were maintained approximately steady at various levels. No influence of the head temperature could be demonstrated. It is further shown that when the surface temperature of an area of human skin is lowered to about 21° C its power of originating sensations of cold becomes faint or is obliterated. The evidence supports the view that 'chemical temperature regulation' is a reflex response of the muscles to sensations of cold.—Miss W. E. Frost. Observations on the reproduction of *Nyctiphanes couchii* (Bell) and *Meganyctiphanes norvegica* (Sars) off the south coast of Ireland. These two euphausiids are the species most abundant in the plankton of the waters off the south coast of Ireland. An account is given of their reproductive cycles, showing the seasonal occurrence and varying abundance of their larvae in the plankton,

a few notes are given on the distribution of the larvae, the reproduction of the two species is compared. Some remarks are made on the euphausiids included in the dietary of herring and mackerel taken off the south, east, and north-east coasts of Ireland, attention is directed to the fact that the larval as well as the adult forms had been eaten.

### PARIS

Academy of Sciences, Dec. 7.—The president announced the death of Sir David Bruce, *correspondant* for the Section of Medicine.—H. Vincent. Notice on Sir David Bruce.—Georges Perrier. Work carried out at the southern end of the Delambre base line, at Melun. The pillar carrying the line indicating the southern end of the Delambre base line (1792–98) has become an obstruction to traffic: it has been lowered below the surface of the road, with precautions to prevent alteration in the length of the base line.—L. Blaringhem, M. Bridel, and Mlle C. Bourdoul. The dominance of the starchy character in hybrids of the first generation of two varieties of pea (*Pisum sativum*).—Jean Rey. The invention of the periscope. A claim for priority.—E. Mathias. Forms of lightning. Theory of formation of lightning resembling a string of beads.—P. Vincensini. A transformation of isotropic congruences.—G. Tzitzéica. Quadratic curves.—F. Marty. The determination of periodic minimum surfaces.—Georges Calugaréano. The necessary and sufficient condition for the univalence of a holomorphic function in a circle.—Miron Nicolesco. Harmonic and subharmonic functions of  $p$  order.—Jacques Devisme. Some partial differential equations.—J. Karamata. The applications of some theorems of inversion to exponential summability.—B. N. Prasad. The convergence of the conjugated series of a Fourier's series.—Florin Vasilescu. A method of Rjabouchinsky having for its object the solution of the problem of Dirichlet, in view of the calculation of the velocity potential.—J. Leray. The slow movement of a viscous fluid in two dimensions limited by fixed walls.—Ch. Racine. The gravitation equations of Einstein.—B. Lyot. The photography of the solar corona apart from eclipses. A detailed account of the precautions found necessary to reduce the instrumental and atmospheric diffusion to a minimum and to amplify the contrasts of the negative. The first results, although imperfect, show that it is possible to follow the changes in the appearance of the interior corona between eclipses.—Ernest Esclangon. Remarks on the preceding note. Emphasising the importance of direct observations being possible on the solar corona.—Ch. Fabry. Remarks on the preceding note.—Jacques Métadier. The general equation of Brownian movement.—Henri Chaumat and Edouard Lefrand. The realisation of electrostatic machines.—A. Grumbach and F. Taboury. The discontinuous variation of the electromotive force of photoelectric batteries with coloured liquids.—R. Hocart and Mlle A. Serres. The magnetic properties and crystalline structure in the different varieties of anhydrous cobalt sulphate. Two varieties of anhydrous cobalt sulphate exist, both crystallised and of orthorhombic symmetry. Their crystalline networks have the same dimensions, but the different structures and change of structure run parallel with the change in magnetic properties.—E. Darmon and Mlle R. Peyroux. The action of boric acid and borax on the rotatory power of glucose, galactose, and fructose.—L. Jacque. The action of petroleums arising from the catalytic hydrogenation of coal-tar as stabilisers. The stability of mixtures of ethyl alcohol and petrol from petroleum is increased by the addition of petrol produced by hydrogenation of coal-tar light oil—

T Karantassis and L Capatos The action of ammonia and amines on germanium tetrachloride. Ammonia gives the compound  $\text{GeI}_4 \cdot 8\text{NH}_3$ . Germanium iodide gives addition compounds with amines containing 4-10 molecules of the base to one of the iodide—Martineau The oxidation of ethyl alcohol by air in the presence of carbon-copper catalysts. The preparation of a copper-coated carbon of high activity, capable of oxidising alcohol at  $66^\circ \text{C}$ , is described—Émile André and Charles Vernier The preparation of  $\alpha$ -phenylethylamine and its separation into its optical isomers—Sebastien Sabetay The synthesis of the *p*-alkyloxy-methyl-benzaldehydes—M Battegay, L Denivelle, and J Meybeck The *N*-chlorosulphonylamides and the *N*-chlorosulphonylsulphonamides—André Kling and Daniel Florentin The mode of action of scission catalysts in hydrogenation cracking of hydrocarbons with a polycyclic nucleus Details of the results obtained by cracking naphthalene and anthracene in the presence of various catalysts Anhydrous aluminium chloride proved the most effective catalyst—Mlle Eglantine Peytral A method of preparation of ketene By a modification of Wilmers' method gaseous ketene containing only 0.5-1 per cent of impurities (carbon monoxide and ethylene) can be collected over mercury—V Babet The organic remains and colthic rocks of the old sedimentary formations of French Equatorial Africa (basins of the Niari and Nyanga)—Breistroffer The Albian level in Chartreuse (Isère and Savoie)—Louis Barrabé The existence of three layers comparable with those of the Germanic Trias in the eastern Corbières—J Devaux The study of the infra-red radiation emitted by the terrestrial atmosphere A preliminary account of results obtained at the summit of the Pic du Midi (2860 metres) with a spectrograph containing a rock salt prism A band at  $10\mu$  appears not to be due to water vapour or carbon dioxide This is probably an emission band of atmospheric ozone—J de Lagaye The visibility of Mont Blanc at the summit of the Puy de Dôme A statistical study of the visibility, with a discussion of the influence of moisture, state of the sky, and barometer—Coulomb Certain rapid long waves (due to earthquakes), and in particular, the wave *PL* of O Somville—Marc Simonet The genetic and cytological study of the hybrid *Iris pallida*  $\times$  *Iris tectorum*—Comandon and de Fonbrune Rhythmic contractions in the pigmentary cells under the action of various poisons—M Fontaine and P Porter The proportion of calcium in the blood of marine fishes In marine fishes the ratio of the globular calcium to the serum calcium is of the same order of magnitude as in the higher vertebrates No relation has been found between the calcium in the serum and the nature of the skeleton, bony or cartilaginous—L Lutz The soluble ferments secreted by the hymenomycete fungi The alcoholic constituents of essential oils and the antioxygen function—A Paillet The morphological variations of the symbiotic bacillus of *Macrocephum tanacetii*.

## CAPE TOWN

Royal Society of South Africa, Oct 21—G Slater The glaciated surfaces of Nootgedacht, near Kimberley, and the upper Dwyka boulder shales of the eastern part of Griqualand West (Cape Province) The evidence in Griqualand West contributes notably to our knowledge of glacial erosion and sedimentation Nootgedacht is a classical area for the study of progressive erosion of the topographical features by land-ice The rock basin contains large outcrops of jointed diabase which display excellent examples of crag and tail phenomena showing in plan the stream-

line form The iceward limb increases in length with progressive decrease in height of the obstruction to ice-movement, and terminates at the crest of a sigmoid curve Abrasion was therefore the dominant form of erosion in the later stages of ice action The leeward limb is associated with 'pluck', more especially in the larger outcrops The section at De Kalk is a type example of the sedimentation of glacial detritus in water The hard bands of tillite-like material represent englacial substance from land-ice which has been deposited as cakes from floating ice.

## ROME

Royal National Academy of the Lincei Communications received during the vacation—L Labocetta Geometric generation of the function  $I x$  and of the other numerical functions,  $Fr x$ ,  $Om x$ ,  $R x$ , associated with it—G Scorza Dragoni Concerning a theorem of Rosenblatt The author's recent criterion of unicity for the solutions of a differential equation assuming definite values in pre-established points, which partly includes an analogous criterion due to Rosenblatt, is developed further—D Mercogliano The equations of the surface of Veronese—G Palozzi Correspondences projectively associated, in a point, to a surface—A Masotti Observations on the plane motion of a system of points in which the centre of the velocity is stationary—A Bellugi The gravimetric depression of Gattatico-Parma—A Baroni Measurement of the parachor applied to the study of the constitution of polysulphides, polyselenides, and mixed sulphur-selenium chains For compounds containing three atoms of sulphur or selenium, these measurements indicate a linear chain, which branches in the case of the tetrasulphide, and exhibits a ring of three sulphur atoms for the two isomeric diethyl pentasulphides, the latter have the structures,



—L Passerini and M. Baccaredda Researches on spinels (4) Sulphochromites of manganese and of cadmium Both manganese sulphochromite,  $\text{MnCr}_2\text{S}_4$ , and cadmium sulphochromite,  $\text{CdCr}_2\text{S}_4$ , exhibit a structure of the spinel type—G Natta and L Passerini Sulpho-salts having spinel structures Zinc sulphochromite belongs structurally to the spinel class and, given the small ionic radius of zinc, it may be assumed that the sulphochromites of other bivalent metals with ionic radii slightly greater than that of zinc possess the same lattice structure—Giulio Cotronei and Celso Guareschi Zoological constitution and grafting Experiments with Anura and Urodela (6)—M Ghiron Enzymes and immunity When the tubercle bacillus is grown in glycerin-broth containing a sterile glycerin suspension of an active lipolytic enzyme isolated from liver, an enfeebled strain of the organism is obtained Moreover, systematic inoculation of the same enzyme during the development of the tubercular process determines an arrest of such process at the first phase of the inflammatory process, which may be followed by cure without further progress of the lesion—G Mezzadrolì and E Varetton Action exerted on the development of silkworms by an open oscillating circuit of copper and zinc, functioning in proximity to a short wave-length radio oscillator Under the influence of these circuits the whole of the life-cycle of the silkworm is accelerated and its development is enhanced, the worms attaining increased robustness and weight Further, spinning is commenced earlier, and the yield of cocoons is augmented 10-15 per cent—P Pasquini Correlative differentiation of the crystalline lens and cornea in the development of anuran and urodele amphibians—

Ada Bolaffi Investigations on the lipoids of human tumours, particularly on the sulphophospholipids of the tumour. All the neoplastic tissues—human or otherwise—investigated by the author exhibit distinct analogies in their lipoidal constitution. They invariably contain a complex sulphophosphorated lipid extractable by means of acetone of specific gravity 0.85, but, if pure, insoluble in the anhydrous solvent. This lipid, which is moderately concentrated in the tumour, probably exhibits a constitutional character specific for each tumour, and represents a substance to some extent characteristic, if not quite specific, for neoplastic tissue. That occurring in human tumours is probably identical with the so-called jecorin.

## Forthcoming Events

### Societies

#### FRIDAY, JANUARY 22

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5—Sir Arthur Keith Malformations of the Human Body considered from a New Point of View (Hunterian Lecture)

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (jointly with Manchester Section) (at Liverpool University), at 6—Dr A. E. Dunstan Liquid Fuels, To-day and To-morrow (Jubilee Memorial Lecture)

ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Sir Arthur Eddington The Expanding Universe

#### SATURDAY, JANUARY 23

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3—A. R. Green Some Interesting Practical Problems in Elementary Geometry

#### MONDAY, JANUARY 25

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5—Sir Arthur Keith Malformations of the Human Body considered from a New Point of View (Hunterian Lecture)

ROYAL SOCIETY OF ARTS, at 8—Capt O. A. Barrand and G. A. Green Life Saving Appliances on Merchant Ships (Thomas Gray Lectures) (2)

#### TUESDAY, JANUARY 26

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15—Prof C. A. Edwards The Progress of Research relating to Physical Metallurgy (2)

#### WEDNESDAY, JANUARY 27

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5—Sir Arthur Keith Malformations of the Human Body considered from a New Point of View (Hunterian Lecture)

BRITISH WOOD PRESERVING ASSOCIATION (at 29 Lincoln's Inn Fields), at 6—K. St. G. Cartwright Diseases of Timber

ROYAL SOCIETY OF ARTS, at 8—Noel Heaton The Permanence of Artists' Materials (Lecture)

#### THURSDAY, JANUARY 28

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15—Prof H. G. Cannon Feeding and Digestion in Invertebrates (2)

#### FRIDAY, JANUARY 29

ROYAL ASTRONOMICAL SOCIETY (Geophysical Meeting), at 5—Prof E. V. Appleton Upper Air Ionisation

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5—Sir Arthur Keith Malformations of the Human Body considered from a New Point of View (Hunterian Lecture)

### Public Lectures.

#### FRIDAY, JANUARY 22

IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5.30—Dr T. M. Finlay The Evolution of Landscape Mountains (Swiney Lectures) (8)

UNIVERSITY COLLEGE, LONDON, at 5.30—Prof H. A. R. Gibb The Expansion of the Arabs, A.D. 600–750

#### SATURDAY, JANUARY 23

HORNIMAN MUSEUM (Forest Hill), at 3.30—M. A. Phillips In the Haunts of the Sea-Birds

#### MONDAY, JANUARY 25

KING'S COLLEGE, LONDON, at 3—C. J. Gadd Assyrian Dealings with Israel

GUY'S HOSPITAL (in Physiological Theatre), at 5—Prof J. M. W. Morison The Use of X-Rays in Physiological Investigations (2) Respiratory Movements

KING'S COLLEGE, LONDON, at 5.30—Prof S. H. Hooke The Myth and Ritual of the Old Testament and the Cultural Patterns of the Ancient East (1)

IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5.30—Dr T. M. Finlay The Evolution of Landscape Glaciers and Land Sculpture (Swiney Lectures) (9)

#### TUESDAY, JANUARY 26

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.15—Dr R. A. O'Brien The Preparation, Testing, and Use of Antitoxin (2)

KING'S COLLEGE, LONDON, at 5.30—H. A. Sieveking Peak Load and Energy Storage (1) (Succeeding Lectures on Feb. 2 and 9)

#### WEDNESDAY, JANUARY 27

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4—Dr R. Fortesque Fox The Rise of the Conception of Rheumatism as a Social Problem

SCHOOL OF ORIENTAL STUDIES (jointly with Royal Anthropological Institute), at 5.15—Prof C. G. Seligman Races of Africa

IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5.30—Dr T. M. Finlay The Evolution of Landscape Britain during the Ice Age (Swiney Lectures) (10)

BELFAST MUSEUM AND ART GALLERY, at 8—A. J. B. Wave Linen Damask

ESSEX HALL (Essex Street, W.C.2), at 8—Dr F. H. Hayward The Message of J. L. Tayler (Tayler Memorial Lecture)

#### THURSDAY, JANUARY 28

SCIENCE MUSEUM (South Kensington), at 4.30—Capt C. J. P. Cave Clouds

KING'S COLLEGE, LONDON (at 16 Russell Square, W.C.1), at 6—S. P. Turin Economic Conditions in Russia To-day (2) Unemployment in Russia

#### FRIDAY, JANUARY 29

IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5.30—Dr T. M. Finlay The Evolution of Landscape The Desert (Swiney Lectures) (11)

#### SATURDAY, JANUARY 30

HORNIMAN MUSEUM (Forest Hill), at 3.30—Dr A. I. Richards Women's Life and Work in a Central African Tribe

## Official Publications Received.

### BRITISH

University College of Wales, Aberystwyth Welsh Plant Breeding Station Self- and Cross-Fertility and Flowering Habits of certain Herbage Grasses and Legumes, together with Studies in Bulb Development and Spikelet Characters in *Arrhenatherum* (Series H, No. 12, Sessions 1921–1930) Pp. 240+2 plates (Aberystwyth) 2s

The British Mycological Society Transactions Edited by J. Ramsbottom, B. F. Barnes and H. Wormald Vol. 16, Parts 2 and 3, December 18 Pp. 89+208 (London Cambridge University Press) 15s

Canada Department of Mines Branch Chrysotile Asbestos in Canada By James Gordon Ross (No. 707) Pp. x+146+34 plates (Ottawa F. A. Acland) 25 cents

Torquay Natural History Society Transactions and Proceedings for the Year 1930–1 Vol. 6, Part 1. Pp. 82 (Torquay)

Department of Scientific and Industrial Research Building Science Abstracts Vol. 4 (New Series), No. 11, November Abstracts Nos. 2010–2247 Pp. 367+402 (London H.M. Stationery Office) 9d net

Museum and Public Gardens Administration Report 1105 M.E. Pp. 18 (Trivandrum)

County Borough of Southport The Fernley Observatory, Southport. Meteorological Department Report, and Results of Observations, for the Year 1930 By Joseph Barendell Pp. 28 (Southport)

- New Zealand Department of Lands and Surveys Annual Report on Public Domains and National Parks of New Zealand Pp 8 Annual Report on Scenery Preservation for the Year ended 31st March 1931. Pp 8 (Wellington, N.Z. W. A. G. Skinner)
- The South African Journal of Science Vol 27 Being the Report of the Twenty ninth Annual Meeting of the South African Association for the Advancement of Science, Grahamstown, 1931, 6 July to 11 July Pp 11+618 (Johannesburg) 30s net
- List of the Transactions, Periodicals and Memoirs in the Library of the Royal College of Surgeons of England Second edition Pp v+169 (London Taylor and Francis) 2s 6d
- The Medical and Scientific Archives of the Adelaide Hospital No 10 (for the Year 1930) Pp 83 (Adelaide Harrison Weir)
- The Journal of the Institute of Metals Vol 46 Edited by G Shaw Scott Pp vi+571+47 plates (London Institute of Metals) 31s 6d net
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- Calendar for 1932 (London The Chemical Trade Journal)





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## Exposition and Authority.

IT is somewhat strange that during General Smuts's recent visit to Great Britain so little attention has been directed to his constructive Sidgwick Lecture on "Democracy" at Newnham College, Cambridge, two years ago, almost every word of which has been underlined by current events "Statesmen are not enough We want to-day the scientific spirit in human affairs" 'It ought to be recognised that the scientific political expert is a necessary institution in national government Great party disputes which threaten the tranquility of the progress of the State should be remitted to a body of experts, where personal character and reputation confer exceptional authority on them, and whose recommendations should be available as a guide for public opinion and the Government"

The constructive truth of these words is attested by most of the inquiries which have been made in Great Britain in recent years, such as that conducted by the Coal Commission in 1926, the Macmillan report, with its warning on the necessity for deliberate planning in the sphere of finance and industry, in place of undirected natural evolution, and the Report of the Committee on Industry and Trade High authorities like Sir William Beveridge maintain that the solution of our unemployment problem is much more a matter of thought and organisation than of money Even political leaders agree on the necessity for closing the dangerous gap between knowledge and power which seriously threatens the continuance of our civilisation, although political events provide an almost unbroken sequence of disregard for facts and scientific method

For this position, as pointed out in recent articles in NATURE, politicians are not alone to blame Alike in domestic and in imperial affairs the scientific community has missed repeated opportunities of active participation in the framing of national and imperial policy, and even now the efforts of the British Science Guild to assess the value of the contribution of science to our national welfare and the potentialities of science in the evolution of a better order of society are largely unsupported

The indifference of politics to facts and its dependence on narrow prejudices are paralleled by the apathy of scientific workers themselves towards public affairs The situation here is the very reverse of that obtaining in Soviet Russia, where, as in Italy, there is danger that political

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considerations may have undue influence on the selection of candidates for a scientific post. In Great Britain a scientific worker who is concerned about the social consequences of the application of scientific discoveries, or takes any active part in public affairs, either in a civic or municipal or national sphere, is apt to find himself regarded askance by his fellow-workers, and his candidature for important professorial posts probably would not be encouraged.

This attitude alone would largely account for the political impotence of scientific workers, which is well illustrated by their inability to return to Parliament, even in a university constituency, a candidate such as Major A. G. Church, who has rendered eminent services to the cause of science in Parliament and won general respect from all parties. Scientific workers at present form merely a disunited section, even in university constituencies, and until their interest in public and professional affairs is sufficiently strong to support united and representative professional associations their political impotence is likely to continue.

Indifference to public affairs finds further expression in certain criticisms levelled against the centenary meetings of the British Association. It has been objected that attempts to provide a general interpretation of science or of scientific topics in the presidential address are misleading to the public and not representative of the views of many scientific workers. Such criticism overlooks the fundamental need for an adequate interpretation of the mission of, and place of, science in human life and affairs and the limited opportunity which at present exists for such an exposition. So few, indeed, have attempted the interpretation in terms which the general public can understand, that it seems ungenerous to criticise those who have made the attempt. The general appreciation which was given to such addresses as Sir William Bragg's on "Craftsmanship and Science" and that of General Smuts are indication enough of their value.

A further objection that the publicity achieved by the British Association would be better attained by organising a more effective service of scientific news for the Press contains a valuable suggestion, but ignores the value and appeal of such a representative gathering of scientific workers in focusing public attention. No scientific meetings throughout the year, whatever their intrinsic merit, can hope to be given anything like the share of public attention that the British Association meetings receive. A visit of an eminent foreign man of science to Great Britain commonly remains un-

noticed by the Press, and few indeed are the scientific lectures which receive more than the briefest paragraph in the daily Press.

This cannot be attributed to the lack of able expositors when all allowance is made for variations in such powers. The clearest lecturer on science receives no greater share of attention than the most famous professor, who finds it difficult to lecture in terms other than those which are intelligible to advanced students alone. Nor can we blame a lack of able writers, for their opportunities are restricted by the modern insistence upon a name or sensationalism. If the ability to express the results of their researches in language which can be generally understood is not widespread among scientific workers, there are, at all events, more competent writers on science than opportunities for their expression.

The difficulty is aggravated because, even in the scientific community, comparatively few have realised the profound difference between genius for research and ease of exposition, and the need for authoritative exposition. It is rare indeed for the two powers to be combined in the one individual. The most casual reading of scientific papers or attendance at scientific lectures reveals that a man may be an outstanding authority and investigator in a particular branch of science and yet unable to give a lecture that can be understood by ordinary people, or write an article or paper which is fully intelligible even to research workers in his own field. The extent to which 'scientific' jargon has invaded all scientific journals is itself a consequence of the general lack of expository powers among scientific workers.

The existence of jargon, which is usually an indication too of loose thinking, is a further barrier to the task of disseminating the knowledge of science in the general community, and the latter task is one which urgently demands fulfilment, if, when scientific workers are able to make representations on national or imperial policy, their representations are to receive a fair hearing. Scientific workers must realise that trained minds devoted to the exposition of the results of scientific discoveries and their application are as essential as minds devoted to the acquisition of fresh facts and discoveries themselves, and scientific workers must be prepared to recognise and honour those who devote their time to the task of exposition and interpretation.

Mischief enough has been worked in the past by relying upon lay interpreters of science. The expositor required to-day must himself have had a

scientific training, be steeped in scientific principles and methods, and able to assess facts and values, and to interpret them in language understood by the common people. His authority is derived not so much from original scientific investigations of his own as from his power of comprehending his subject, assessing values, and understanding his public. In such exposition he will require the same qualities of mind and the unswerving loyalty to truth which his brother worker requires in his laboratory researches. Exposition is an art, and the imagination of mankind will only be fully touched by the achievements of science, and man roused to a wider application of scientific method, when innumerable artists of science, great and small, in utter fidelity to truth—to science as to life—have made plain its mysteries in words understood of all.

The formidable prejudices which exist against the expositor, who is commonly confounded with the demagogue or propagandist, are found even more among scientific workers than among the general public and the Press. Carlyle's assertion is uncomfortably true of the general scientific community: "Man is and was, always . . . much readier to feel and digest, than to think and consider. Prejudice, which he pretends to hate, is his absolute lawgiver; mere use and wont everywhere leads him by the nose." The prejudice of the scientific worker against participation in public affairs, and the prejudice of public and Press against the contribution of scientific workers who are disposed to public service, are mainly responsible for the gap between knowledge and leadership and the serious lag which has already developed between our rapid scientific advance and our stationary ethical development. These are among the prejudices which endanger the continuance of civilisation and which, as Sir Arthur Keith has warned us, must be mastered as a condition of its survival. The prejudice against exposition may be only a contributory cause, which hinders the task of educating the community as to the value of the contribution of science to the progress and well-being of society and its vast latent possibilities for the evolution and planning of a more balanced order. Interpreters of the right type will never be forthcoming in sufficient numbers until scientific workers are willing to accord to them honour where honour is due and to assist them by sympathetic and not unfriendly criticism. Fundamentally, the education of public opinion in this matter is a responsibility which scientific workers cannot evade.

While the ultimate solution may be found in education, we cannot wait on that slow process

alone. Already industry is showing the way, even in Great Britain, to relate leadership and knowledge, and scientific workers must address themselves not only to the task of educating public opinion on the importance of this issue, but also must increasingly show by the force of example the value of the contribution which science makes to human welfare. Through their position in industry, and through their professional organisations, scientific workers have already opportunities of bringing far greater influence to bear on public affairs if they would but forget their prejudices and unite for common action. Nor should the existing organisations be inadequate to secure that the profession of science be represented in Parliament by those competent to exercise the authority which is combined with knowledge, provided there be the will to this end. A wider use of existing opportunities by scientific workers should do much to close this gap and disarm the prejudices of the public and Press against the authority of science, and it is unlikely that any more important opportunity for publicity and service could be found than those afforded by just those representative gatherings of scientific workers among which the British Association meetings are pre-eminent.

### Science and Human Experience.

*Science and Human Experience* By Prof Herbert Dingle. Pp 141 (London: Williams and Norgate, Ltd., 1931) 6s net.

IN addition to the renowned protagonists of mathematical physics and cosmical astronomy, of whom Eddington and Jeans are the best known in Great Britain, but of whom also many others are recognised, for example, De Sitter of The Hague, Max Planck of Berlin, H. N. Russell of Princeton, E. A. Milne of Oxford, Bohr and Heisenberg of Copenhagen, not to mention other well-known names, such as R. H. Fowler, C. G. Darwin, the Thomsons, and many more, there has now arisen one who apparently is well acquainted with the work of all these geniuses, but finds it possible to differ from them in several important particulars, and with a cultivated historic sense to review the progress of physics from the days of Copernicus and Galileo to the present time. This writer is Dr. Herbert Dingle, honorary secretary of the Royal Astronomical Society, and assistant professor of astrophysics at the Imperial College, South Kensington. He has written a compact book, mainly on the philosophy of physics, but incidentally on the philosophy of science in general.

He claims to have written it, not for philosophers, who have technicalities of their own which he does not pretend to criticise, but for scientific men themselves. Naturally he deals primarily with mathematics and physics, but hopes that his treatment will be applicable and useful in all departments of science, the unity of which he thinks is far more important than their differences. For he has a

"strong conviction that the boundaries which separate the physical, biological, and psychological sciences are only temporary conveniences which will one day disappear, perhaps as completely as the boundary between chemistry and physics has already done"

He says:

"Historically, Science is a special kind of philosophy, and indeed the inquiry into the nature of Science . . . must be a metaphysical inquiry"

"The unspecialised thinker [he says] is most conscious of the activities of Science through the inroads which it makes into his æsthetic, moral, and religious ideas"

This last fact it is perhaps which has led to the almost universal interest in the great questions of cosmogony. The ordinary man

"wants to know, perhaps with mingled hope and fear, how much farther Science can go in prescribing the character of the world in which his lot is cast. He is interested to know that the universe is a bigger thing than his forefathers imagined, but he is still more interested in the question whether it is a better thing. He wants to know what this Science is in itself, what power for both construction and destruction is given to it, so that he may employ it in building his own intellectual habitation on a foundation which it is powerless to undermine. It is towards the solution of this problem that in this book I shall attempt to make a preliminary contribution"

Prof. Dingle evidently thinks that science can be of use or of harm in non-scientific domains, such as those of art, criticism, and religion, and he deals with these in an illustrative kind of way in the last three chapters of the book. Apart from this, and speaking as a physicist, he says

"The book has two purposes. In the first place it proposes an interpretation of the present position of physics, which seems to me to make rational what at first sight appears fantastic. The second purpose of the book is to provide, for the ordinary intelligent reader, an account of the remarkable changes in recent physical thought which have excited so much general interest. The new ideas [did not arrive] as a bolt from the blue, destroying at a blow the familiar beliefs of the past. They emerged gradually from the thoughts and labours of former generations, and now that they have come to light we can recognise in them

the natural blossoming of seeds of thought planted long ago"

This gradual evolution is one of the things Prof. Dingle tries to demonstrate.

Evidently the book is one that must be taken seriously. In so far as the author opposes the presentation of some of the ideas of men whom nevertheless he greatly admires, then, so long as he fully understands the meaning of their statements, he will be performing a useful and much needed purpose, for it is quite unlikely that the new physics as generally promulgated is right in every particular, and yet there are very few who have a knowledge which renders them competent to criticise.

It is not for a reviewer to attempt to decide which side is right and which is wrong in this battle of giants. He can but direct attention to the philosophic controversy which is here raised in a well-informed and polite and far-reaching manner with at least one example to illustrate any general statement.

The author starts off with the definition of the field or scope of science. He does not mean to exclude other branches of human knowledge from full attention, but he would exclude them from what he means and understands by 'science' in the strict sense. The definition runs thus:

"What, then, do we mean by Science? I take it to be *the recording, augmentation, and rational correlation of those elements of our experience which are actually or potentially common to all normal people*,"

and every word is evidently carefully weighed. In connexion with this definition, he emphatically contends that the experiences susceptible to scientific treatment must be 'common' experiences, not individual. He goes on to explain what he means by 'potential experiences', and also what he means by 'normal people', this last part of the definition giving him some trouble. Some readers will protest that this definition of the term 'science' is needlessly narrow, but when interpreting the author's contentions and occasional limitations, his definition should be borne in mind.

All this is introductory to the main theme of the book, which begins with interesting quotations from Copernicus and Galileo, and then goes on to criticise the attitude of Newton. In Galileo's view, says the author, the whole of objective Nature was susceptible of mathematical interpretation, and this he likens to Sir Arthur Eddington's limitation of physical science to pointer readings and metrical qualities. It is pointed out, however, that things

which Galileo would have treated as non-metrical, and therefore of the nature of secondary qualities, were after all susceptible of measurement, as illustrated for example by Newton's treatment of colour, so that the metrical world is more comprehensive than Galileo conceived it to be. Moreover, there are many undoubted parts of science which are non-metrical.

After a criticism of Newton's philosophy, Prof Dingle proceeds to consider the two great methods of scientific advance, one being *abstraction*, the other *hypothesis*. Physics has proceeded mainly by abstraction, biology and chemistry perhaps mainly by hypothesis. He has interesting things to say about these two methods. Abstraction proceeds mainly by subtracting from observed phenomena everything that can be regarded as non-essential, whereas hypothesis adds to observed phenomena something—it may be a guess—which is not displayed by the phenomena themselves. The atomic view of chemistry, for example, and the biological origin of species, are hypotheses. When a hypothesis is verified it becomes a *fact*, and science is enriched. There is another kind of hypothesis which can never be verified. These are serviceable for correlation, and can be justified because they do correlate a mass of phenomena. Such hypotheses may be regarded as tools, whereby facts and relations can be established. If an event is outside experience it can enter science only as a tool.

"As biologists it does not matter to us whether the higher forms of life actually emerged from the lower ones or not. The hypothesis that they did so emerge correlates our observations, as well as a conception as it would do as a reality, and we can therefore employ it so long as it continues to be of value."

Hypotheses are unverifiable when they refer to events which took place in the past, such as the origin of the solar system, for example. But they also may be unverifiable if they cannot be observed, like the formation of atoms from protons and electrons, or the whole of ultra-microscopic physics. Such hypotheses may nevertheless have a correlating value, and may thus ultimately be justified.

Prof Dingle illustrates the introduction of hypotheses into physics by three stages—one of 1687, by Newton himself, where he opposes all hypotheses as not deducible from the phenomena, the second stage, 1796, from Laplace, where he presents the nebular hypothesis with diffidence, as one which though highly probable is not the result of observation and computation, the third is from Eddington, 1926, where he regards the

macroscopic equations as 'useful tools', and the microscopic view as containing "the real truth as to what is actually occurring". Prof Dingle, after summarising the three stages—impermissible, highly probable, the real truth,—goes on to say that the whole microscopic scheme of physics belongs to the class of events the unobservability of which is part of their essential nature, and which therefore we presume can only be regarded as a hypothesis that is used for purposes of correlation.

The second law of thermodynamics he takes as an interesting example of the parallelism between abstractions from observation and the elaborations of the atomic hypothesis. It was originally formulated as representing deductions from large-scale phenomena, from which it is an abstraction, but it has now been formulated as having complete universality of application to the hypothetical atoms.

In Chap. iv the author takes as an "extremity of abstraction" the theory of relativity. The following quotation may serve to illustrate.

"The net result of Einstein's great theory, then, is that we can now regard the whole mechanical and electro-magnetic phenomena of Nature as a manifestation of the characteristics of one abstract medium—space-time, or ether, or whatever else we care to call it. The Newtonian conceptions of space, time, mass, gravitation, momentum, as well as energy and electric and magnetic forces, all take their places as specified peculiarities of this medium. To Newton, space and time were the stage on which the drama of forces and motions was played. To Einstein, the drama is merged into the stage, the play is the scenery. Abstraction can hardly go further. It has made the diverse phenomena of Nature into a universe, but at the expense of all individuality. The world is united, but featureless."

In Chap. v Prof Dingle deals with the "extremity of hypothesis", which he illustrates by the quantum theory. The emission and absorption of light are thereby 'explained' on a basis of a solar-system structure for the atom, subject to essentially arbitrary conventions.

"The electron is not something imaginable, but a pure thought-structure. It is therefore useless, and even positively harmful, to try to picture it. Relativity is abstracted from our experience of phenomena, it surprises us because it reveals possibilities of experience which we never contemplated. The quantum theory surprises us because it reveals impossibilities of experience which we never contemplated, we thought we were justified in extending to atoms the abstractions discussed in relativity, and we find that we were not."

In Chap. vi the author deals with "Experience

and Physical Theory", or what he calls "The common-sense of it all"

We have thus summarised the first half of the book, which now begins to get very interesting for the ordinary reader. In Chap. vii the author controverts Eddington's limitation of science to the metrical elements of phenomena, claiming that those concepts are not entitled to a monopoly of the realm of science. In the next chapter he attacks the great writers on the question of determinism, or rather indeterminism, as applied to atomic phenomena, and has some illuminating remarks on uncertainty and probability. The remaining chapters deal with "Science and Art", "Science and Criticism", "Science and Religion", subjects of which a treatment is evidently of intense importance to all except the unduly specialised, if they are dealt with (as they are) in the light of great and competent physical knowledge. These chapters contain a wealth of illustration from literature, and are very interesting and suggestive. Whether one wholly agrees with the author or not, the book is an achievement of first-rate value.

OLIVER LODGE

#### Progressive Entomology.

*Recent Advances in Entomology* By Dr A. D. Imms (The Recent Advances Series) Pp viii + 374 (London J and A Churchill, 1931) 12s 6d

IF the quantity and quality of published work is a safe criterion of the vitality of a science, entomology is showing no apparent signs of decay. On the contrary, it is displaying all the symptoms of a normal and vigorous growth. So intensively is research being prosecuted on both the pure and applied sides, that it is becoming increasingly difficult for the individual to keep himself conversant with the various advances that are being continually made. More and more the field of experimental activity is being enlarged in the search of new facts that may be utilised in man's struggle for ascendancy over the insect hordes that frequently threaten his very existence. At the same time investigation of purely morphological problems proceeds apace, unravelling the complexities of insect structure and function and shedding new light on the problems of relationship and ancestry. In the interests of further progress it is essential that the results of this vast volume of work should be submitted periodically to critical review and analysis.

For the successful accomplishment of such a task Dr Imms would appear to be the logical choice, in

that he brings to bear upon the work a mind that has been abundantly enriched, both by the diversity of his own researches and by an intimate acquaintance with the general mass of entomological literature that is wellnigh unsurpassed. No matter what the individual's attitude to the subject, entomology, may be—general student, investigator, or teacher—all will profit from the careful perusal of this book, in which the difficulties, so far from being shunned, have been courageously tackled and rendered attractive by reason of a consistently lucid exposition.

In virtue of the subject matter of the book, the account of it must necessarily be in the form of a review of reviews. The 'advances' are classified under morphology, metamorphosis, palæontology, sense organs, coloration, ecology, parasitism, and biological control. In the province of morphology the author discusses the various theories of the segmentation of the insect head, the homologies of wing-venation, and the probable derivation of metameric appendages from the biramous limbs of the higher Crustacea.

So far as metamorphosis is concerned, no satisfactory explanation of diverse larval types had materialised until Berlese emphasised the existence of three distinct embryonic phases—protopod, polypod, and oligopod—with which the principal larval types appear to conform. Larvæ emerge from the egg in different stages of morphological development. Those of holometabolous insects are hatched in a more primitive condition than the hemimetabolous. Consequently, there supervenes a highly specialised cœnogenetic development, which demands a pupal period of quiescence, during which transformation to the adult occurs. In insects, as in other animals, ontogeny is a recapitulation of phylogeny. But it must be remembered that ontogeny is subject to abbreviation and to masking by secondary non-ancestral features.

In the field of palæontology the researches of Handlirsch and Tillyard have considerably extended our knowledge of the probable trend of evolution in the principal insect orders. It is now generally accepted that the Exopterygota arose from the Palæodictyoptera of the Upper Carboniferous. The Endopterygota, on the other hand, would appear to have a tri-radiate ancestry, the lines of which diverged into the Mecoptera, Hymenoptera, and Coleoptera. Whilst these advances are eminently satisfactory, they contribute nothing to the solution of the two main problems of insect phylogeny—(1) the origin of insects as a class, (2) the origin of insect wings. It is to be hoped that



future discoveries will provide the clue to these fundamental questions

Chapters v and vi deal with the various sensory organs of insects, optic, olfactory, gustatory, tactile, and auditory, and end with an interesting discussion of the relationship of insect behaviour—chiefly reactions to chemical and photic stimuli—to applied entomology. Reflex behaviour is intimately associated with the functioning of sense receptors, which are either aggregated to form complex sense organs or diffusely distributed over the body as isolated sensillæ. Whilst the exact rôle of the latter is difficult to diagnose experimentally because of their minute size and heterogeneity, histological structure may occasionally suggest their correlation with determinate responses of the individual under specific stimulation. Both from the point of view of structure and experiment, it is not difficult to ascribe to the tympanal organs of insects an auditory function. In these, groups of sensillæ or scolopalæ are identified with a tympanum, all of which is strongly suggestive of an ear. In the scattered simple ligamentous chordotonal organs a definite tympanum is absent, but the scolopalæ are identical with those of tympanal organs. Eggers, who has studied the question meticulously, believes that the latter are 'rhythmometers', which co-ordinate and regulate intrinsic muscular movements. There is, however, no good reason why they should not also be considered as receptors of extrinsic vibrations in the surrounding medium, and they would thus be fundamentally similar to those chordotonal sensillæ that are combined to form definite organs.

The essentials of the theories of structural, pigmentary, and combination colours are excellently presented. The significance of coloration in the physiological processes of the individual tends, as the author remarks, to be relegated to the background. The subject of protective coloration has been widely discussed in entomological literature, and whilst the adherents of the theory of natural selection have invariably stressed, with no satisfactory proofs, the effect of the environment on the colour schemes of insects, they have entirely failed to realise that such a simple explanation is not readily tenable, since colour is the result of an intricate chain of chemico-physical processes within the organism.

Insect ecology and its practical application to the control of injurious species is assuming greater importance as time passes. It is generally recognised that the metabolism, behaviour, and distribution of insects are in great measure controlled by the

physical factors of the environment, and the principles that have been formulated as the result of experimental methods are of considerable significance in particular cases. A notable example is that of the Hessian fly, the attacks of which in North America have been in great measure circumvented by postponing the sowing of winter wheat in the autumn until the second generation of the fly has succumbed to the operation of natural lethal factors in the environment. In England, as a result of the information acquired through the experiments of Frew concerning the oviposition habits of the gout-fly, an important pest of barley, it was found that manurial treatment of the crop so alters the relative growth of stem and ear as to effect a reduction of the number of 'critical' leaves arising above the ear. The fly is thus forced to deposit the greater proportion of its eggs on the 'non-critical' leaves below the ear, with the result that the downwardly migrating maggots miss the vulnerable ear and finally succumb at the base of the ensheathing leaves of the stem.

The important phase theory of locusts advanced in 1921 by Uvarov, which appears to be amply supported by the evidence of recent field investigations, receives due notice. Whilst the theory does not pretend to explain the periodicity of locust outbreaks, it at least sheds light on the solitary and gregarious forms of these insects and their transition one to another. The value of the theory lies in the fact that the research worker is now provided with an instrument by means of which the whole problem of locust control may be thoroughly explored. All that is now required is the provision of financial aid sufficient to establish a competent international locust research organisation as Uvarov has advocated.

In order to deal adequately with the recent extensive research activities in parasitism and biological control, the author has found it necessary to devote the last hundred pages to their consideration. Ample attention is paid to the principles of host selection, the various expressions of parasitism, such as multi-, super-, hyper-, endo-, and ectoparasitism, the host relations of parasites, and the phenomenon of polyembryony in the Chalcidoidea, Proctotrypoidea and Vespoidea. The several aspects of biological control are fully discussed. Beginning with the introduction of *Vedalia cardinalis* into California to combat the cottony-cushion scale, the author then proceeds to describe the strenuous efforts to control the gipsy and brown-tail moths in New England, the mulberry scale in Italy, the levuana caterpillar in Fiji, and the larch sawfly in Canada, to mention but a few. Finally, due

consideration is given to the factors governing parasitic introductions, the utilisation of indigenous parasites, and the biological control of noxious weeds

It only remains to say that typographical errors are few, that the illustrations, of which there are eighty-four, have been well chosen, and that there is both a general and an authors' index. The ample bibliographies at the end of each chapter will serve as a useful guide to the sources of further information

A. E. CAMERON

### An Encyclopædia of Scientific Agriculture

*Baillière's Encyclopædia of Scientific Agriculture*  
 Edited by Dr Herbert Hunter. In 2 volumes  
 Vol 1 A-L Pp xvi+675+plates 1-17 Vol  
 2 M-Z Pp 677-1361+plates 18-29 (London  
 Baillière, Tindall and Cox, 1931) 63s net

**A**BSTRACTING journals and periodic reviews of progress, by which the pure sciences meet the difficulty of the rapid growth of their literature, leave certain needs in agricultural science unsatisfied. In their applications to farming practice the various sciences become closely interdependent and, also, the scientific worker in agriculture must watch closely the alterations and advances in practical husbandry. Further, the practitioner, with science bearing ever more forcibly upon his activities, stands in need of a specially prepared presentation of its applications to his industry. An encyclopædia of scientific agriculture is thus a logical and timely enterprise in which the investigator, the teacher, the student, and the farmer are certain to be interested.

In forming a first judgment of an encyclopædia, one must be guided largely by the ideas upon which the work is based. The principle adopted has been to present the various branches of agriculture in the forms they have assumed under the influence of science. An acquaintance with the chief customary operations and the equipment of husbandry on the part of the reader has been assumed. With these ideas in mind there has been enlisted the help of an unquestionably authoritative body of contributors, nearly ninety in number. Supplementing the original articles of the contributors is a considerable body of descriptive matter arranged, like the articles themselves, alphabetically. Choice and composition of this descriptive matter must have been very difficult. Whether in some cases the editor may not have been too indulgent may perhaps be questioned, but it is certain that his selection will prove helpful to all the types of reader he has endeavoured to serve.

A very wide range is covered by the original articles, but certain important branches of agriculture have, by design, been excluded. Livestock is the most important of these, the reason being, here, that the breeds, management, etc., have a full, up-to-date literature of their own. Poultry, however, relatively new to commercial farming in Great Britain, is covered in all its aspects by excellent articles. To exclude animal diseases was inevitable, for a popular account would not have been in keeping with the purpose of the "Encyclopædia", while descriptions of recent advances and current problems would have unduly strained its scope. It is, perhaps, to be regretted that the important applications of physical chemistry to fungicide and spray materials has found no place.

In their writings on the soil, crop varieties, animal nutrition, fruit and vegetable crops, storage, and marketing, the contributors have assembled new knowledge for which any but the specialist would formerly have had to search through a very scattered field of publications. In not a few cases, the original articles, in addition to their value in building up the "Encyclopædia", are distinct and welcome contributions to the literature of their subject. Certain fields have been covered in which no precise applications to practice have yet emerged but in which knowledge has made important recent advances. Drought resistance and the influence of low temperatures upon plant growth are among these special cases, the inclusion of which is a great asset to the work.

Room is found for some subjects not directly suggested by the title of the "Encyclopædia". Thus certain legal enactments are included for the sound reason that these are based upon chemical or other scientific evidence. There is, too, a series of articles describing the agriculture of the British Dominions and of some of the Colonies. The importance of these stands out clearly in the light of recent research and, even more, of the present economic situation.

The merits of an encyclopædia, whether as to choice of matter or arrangement, can be gauged only by using it for reference in normal fashion over a considerable time. But a first inspection leads to the belief that the many interests comprised by the broad field of agriculture and its sciences will find in the "Encyclopædia of Scientific Agriculture" a ready and dependable source of help. The publishers are to be commended for the nature and magnitude of their enterprise and congratulated upon the hands to which they entrusted it.

## Short Reviews.

*The Journal of the Institute of Metals* Vol 46  
 Edited by G Shaw Scott Pp xii + 571 + 47  
 plates (London Institute of Metals, 1931)  
 31s 6d net

THE high reputation of the *Journal of the Institute of Metals* is worthily maintained by the latest issue. Commencing with the Autumn Lecture on "Thin Films in Relation to Corrosion Problems", by U R Evans, several subsequent papers deal with allied questions. The increasing use of the spectroscope in industry is shown by two contributions on this subject, which, together with the discussion upon them, represent substantial addition to our knowledge in this direction. Two further papers, both by Prof Hanson and Mr Slater, deal with the causes and the elimination of unsoundness in sand castings of aluminium. The profound influence of water vapour in the furnace atmospheres is most clearly demonstrated, and the importance of the conditions under which the metal is stored between the time it is first produced and that at which it is cast is emphasised. Three papers deal with the subject of the drawing of wire: two with the nature of the flow and the factors which affect it, the third with the changes of tensile strength of high conductivity copper as it is drawn down.

One of the most outstanding features of this volume is the remarkably wide range of the researches published, and few who are interested either in general metallurgy, or in specific metallurgical processes, can fail to find much of direct interest. In addition to the topics already mentioned, others dealt with include the production of copper-nickel alloys of high elastic limit, the application of electric furnaces to the manufacture and working up of the non-ferrous metals, the effects of cold-rolling and heat-treatment on alloys of lead, the ageing of duralumin, etc. The proportion of papers of practical importance is unusually high, but the purely metallographic aspects of the Institute's interests are equally well represented. If one of such papers may be selected, attention may be directed to that of J A Murphy on the silver-mercury diagram, which is of more than usual difficulty and merit. F C T

*Social Behaviour in Insects* By Dr A D Imms  
 (Methuen's Monographs on Biological Subjects)  
 Pp ix + 117 (London Methuen and Co, Ltd,  
 1931) 3s 6d net

A SOCIAL system, existing in small winged or wingless insects, long before man had evolved, having its *raison d'être* in instinct and physiology rather than intelligence, yet possessing remarkable similarities to the system which man built round himself! What more fascinating study could one find in the realm of Nature than that of these six-legged creatures. Like us, they care for their young, nursing them in cradles and feeding them on the most appropriate food. They may keep armies for defence or aggression, or may turn to the

peaceful pursuits of the dairy-farmer and husbandman. They even have sufficient sense of property to leave real estate to their offspring.

In this little book, Dr Imms sets out to explain the behaviour of social insects, the basis of this behaviour in morphology, and the paths which they may be supposed to have traversed in evolution. The big majority of insects are solitary creatures, independent of each other, except for reproductive purposes. They die soon after oviposition and therefore have little opportunity to become interested in their offspring.

A striking clue to the evolution of communal life in these animals is to be found in sub-social forms where the family system is in process of establishment. Here we learn of the great significance which attaches itself to reciprocal feeding between adult and young forms, to the exploitation of flowers, and the dependence, total or partial, of caste formation and its associated polymorphism, on nutrition. How far the condition presented to us—of a vast proletariat of sterile working classes, each individual merged into the community, to which it may at any time be mercilessly sacrificed—is one to be emulated or not, the reader may decide. Many will agree with the author and "take comfort that a system of this kind is unattainable by repressive manifestations on the part of the most ruthless human dictatorship."

*Forest Life and Adventures in the Malay Archipelago.*

By Dr Eric Mjöberg. Translated from the Swedish by A Barwell. Pp 201 + 84 plates  
 (London George Allen and Unwin, Ltd, 1930)  
 12s 6d net

ANYONE desirous of prosecuting a biological research expedition to the tropics would be well advised to read this little book, which is charmingly written and illustrated, and equally well translated. In the thirty-one chapters, "each complete in itself and requiring no further index", we read of such giants of the forest as the elephant, the rhinoceros, and the buffalo, delighting as much in the habits of them as in the exciting incidents of the hunt. The goat-antelope, living in impenetrable tracts round volcano summits and only seen once before by a white man, is described and pictured to us. We are told that though it is two-horned, it is to this animal that we must refer the mythical unicorn. Another interesting mammal is the scaly, hairless ant-eater or pangolin, which simulates death amid myriads of ants. When in their hunger and curiosity enough ants have entered beneath the scales, the pangolin shuts these down and calmly enters the nearest pool. The ants, on release, rise to the surface of the water, from whence they are skimmed by means of his sticky tongue.

Space is not available to do more than mention here such marvels of Nature as the flying frog, poisonous fish, fish which walk on land, the trilobite larva, 2½ inches long—neotenic females whose mates are insignificant blue-black beetles no longer than one-fifth of an inch. To the author belongs the honour of having solved this century-old enigma.

Mjöberg is as interested in the Malayan native

as he is in the flora and fauna, and it is to the friendships which he struck with these people, who are still as likely to collect human heads as camphor, that he owes much of his information

*Die Tierwelt der Nord- und Ostsee* Begründet von G Grimpe und E Wagler Herausgegeben von G Grimpe Lieferung 18 Teil 10a *Phyllopoda*, von Walther Rammner, Teil 10e<sub>2</sub> *Isopoda genuina*, von H F Nierstrasz und J H Schuurmans Stekhoven, Jr, Teil 10e<sub>3</sub> *Anisopoda*, von H F Nierstrasz und J H Schuurmans Stekhoven, Jr, Teil 10e<sub>4</sub> *Isopoda*, Nachtrage und Berichtigungen, Inhaltsübersicht Pp 32+77+34+5 (Leipzig Akademische Verlagsgesellschaft m b H, 1930) 13 50 gold marks

THE present section containing the Phyllopoda and the Isopoda is a most useful addition to this series of short monographs on the various groups in the fauna of the North Sea and Baltic. There are few Cladocera in the area covered. *Podon* and *Eradne* are the only truly marine genera, *Bosmina coregoni maritima* being a variety of a freshwater species which is capable of living in the low salinity of the Baltic. The general account of these is full and well illustrated. The remainder of the section, and by far the greater portion, is taken up with the Isopoda, divided into *Isopoda genuina* and *Anisopoda*. Here we have abundant material in both divisions. In the first part, after very brief notes on anatomy and biology, with a table of distribution of all the species to be found in the Baltic and North Sea (81 in all), the account is a systematic one. This is extremely useful, for, with the exception of Sars' "Isopoda" in "An Account of the Crustacea of Norway", there is no work which describes and figures all the species in detail. Nearly all the illustrations are actually taken from Sars' own figures and are excellent. Parasitic species, of which there are many, are also included. The section on *Anisopoda* is on the same lines and equally well illustrated.

*Nature in the Garden Wild Life at our Doors* By Edward Step In 2 volumes (The "Come-with-Me" Books) *Early Days to Early Summer* Pp x+149+31 plates *Midsummer to Winter* Pp x+149+31 plates (London and New York: Frederick Warne and Co, Ltd, 1931) 2s 6d net each vol

IT is a pleasure to pick up a work such as the late Mr Edward Step has given us in his "Nature in the Garden". The irresistibly charming intimacy with which the author treats his subject by taking his readers on a Nature ramble around any typical English garden, whether in the town or country, will induce many to indulge in a pleasurable study of these two volumes. It is surprising what a vast amount of fact and helpful knowledge has been packed into these two small books, and after reading them through it is difficult to conceive of anyone failing to feel a greater interest in the natural history of his garden.

The numerous plates and illustrations are a great asset and show care taken over detail, besides being

helpful and instructive to the reader. Without hesitation we may say that this work entirely fulfils the intention of the author, namely, to explain in simple non-technical language a few of the more obvious natural forms that appear in almost every garden. An added interest lies in the assurance given by the author that all the creatures mentioned in the pages of his two volumes were actually found by him in one or other of the gardens which he had owned from time to time.

*Jungle Ways* By Wilham B Seabrook Pp 316 (32 plates) (London, Bombay and Sydney: George G Harrap and Co, Ltd, 1931) 10s 6d net

MR SEABROOK, as he has shown in his previous writings, is keenly interested in all manifestations of magic and the occult. His visit to Africa, in fact, was largely inspired by a desire to study African magic in its native home as a result of his experience of voodoo in Hayti. His journey in French West Africa fell into four stages. He began in the Ivory Coast area among the Yafouba, an excellent district for the study of magic. He then went on to the Gueré cannibals. An interlude at Timbuctoo was followed by a visit to the Habbé cliff-dwellers. When the author was with the Yafouba he was taken under the wing of a young witch and with her assistance had an excellent opportunity of observing the working of magic in everyday life. He also witnessed a remarkable exhibition of the impaling of young girls on swords. He is no more able to offer an explanation than others who have seen similar performances elsewhere. Among the Gueré he experimented in cannibalism, and describes in some detail the appearance and preparation of the dish and his sensations before, during, and after. In the last section of the book are some striking pictures of phallic rites. The merit of the book lies in its vivid descriptions rather than in its additions to scientific knowledge.

*Field Book of Ponds and Streams an Introduction to the Life of Fresh Water* By Prof Ann Haven Morgan (Putnam's Nature Field Books) Pp xvi+448+23 plates (New York and London: G P Putnam's Sons, 1930) 15s net

A USEFUL book, well qualified to meet the needs of the naturalist anxious to learn about the many members of the flora and fauna of fresh waters. It cannot be expected that such a work could always guide to specific determinations, but often it does so, and the illustrations and descriptions of habits are so definitely to the point that the honest student may attain generic accuracy. Two chapters on varieties of habitat and methods of preserving water animals make an excellent introduction. Unfortunately for us, the book is concerned with American forms of life, and although fresh-water faunas bear a great resemblance the world over, there are groups, especially the vertebrate groups, which scarcely apply to Great Britain. A similar compact ecological treatment of our own fresh-water faunas would be a boon to students on this side of the Atlantic.

## Petroleum in Australia

SO much has been heard in the past concerning the prospects of commercial oil supply from indigenous resources of the Commonwealth, that mere mention of the subject is inclined to call forth expressions of scepticism and recollections of past disappointments. But whatever opinion may prevail in technical or financial circles at the moment, perusal of Dr W G Woolnough's report of his tour of inspection of the oilfields of America and Argentina, as bearing on prospects in Australia,\* is certainly worth while, if it does not convince in its object, it at least provides a most readable account of the industry in the first two countries, and a very fearless statement of the facts as regards Australia.

The dictum that "nobody but an optimist ever discovered oil" may be taken as the key-word of this report. Dr Woolnough is clearly an optimist, but his is an optimism based on sober statement of facts, not on extravagant claims. He has toured the Americas widely and has learnt much, as everyone does who makes a similar journey, from the generous insight into the industry which is accorded the visitor. There is scarcely a single phase of the industry which is not discussed or referred to in its bearing on modern practice and tendencies throughout the oil centres of the world, and the author of this report is equally loud in his condemnation of the unsound as he is in praise of the activities which have made the American petroleum industry what it is to-day.

What seems to be needed in Australia, *pace* past efforts and all that has been written on the subject, is first of all a totally different attitude on the part of the public as a whole towards the actual prospect of finding oil. As in recurrent instances in the history of the American industry, the word petroleum has too often been interpreted in terms of stock-market activities, exploration should be unaccompanied by gambling in shares of companies, the claim of which to assets may only lie in mineral rights or prospecting rights. Exploration for oil needs money (seldom contributed from share funds), patience, up-to-date technique, and first-class initial research. Dr Woolnough shows that Australians have a great deal to learn in the way of setting about to establish the claim that oil does indeed exist in the continent, and he is clearly impressed with the lessons that can be learnt from American operators.

In some respects it is a pity that this report has come at a time when the financial resources of the country are strained, and when economic conditions generally are against further bold enterprise to probe the question of oil prospects. While the competent geologist, weighing up his claims, may not agree with many of Dr Woolnough's opinions in a broad way, there is no doubting the sincerity of purpose underlying his estimate of possibilities,

and it would be a thousand pities if, because the moment is inopportune, his work were to be shelved and possibly forgotten. His arguments are interesting. The widespread belief that Australia is geologically too old to contain petroleum, he regards as fallacious. Equally valueless—and here we are at one with him—are the ideas that oil cannot occur commercially south of the equator, other than in tropical regions, and that "there has been a special dispensation of Providence in favour of the United States" in the matter of petroleum supplies. Again, indifferently qualified (and often incompetent) oil men drift from America into Australia, set themselves up as 'experts', from whom come some of the inaccurately worded prospectuses which have in the past misled the public. This sort of thing is checked to some extent in America by protective legislation, it should be similarly checked in the Commonwealth.

Paying tribute to the good work done in Australia in connexion with oil exploration in the past, Dr Woolnough states quite unequivocally that nowhere does that work approximate in detail or completeness with the ordinary routine in the American oilfields. This is probably correct, but it must be borne in mind that had a really substantial oilfield been discovered in Australia, even by the 'blind stabbing' methods of the old days in the United States, such routine efficiency would have come about automatically, and comparisons would not to-day have been so unfavourable between the methods of the two countries. For what has been wanted, quite apart from a change of attitude of Government and people, has been the actual finding of a good field. In other words, the encouragement which achievement gives. Had there been a really lucky find in the past—the discovery of an oilfield of commercial magnitude comparable with any one of the unit-producing oilfields of the States during the last twenty years—the whole trend of the search for oil in the island continent would have been altered.

Another sidelight on Australian conditions may be quoted verbatim. "It cannot be too strongly insisted that absolute freedom of entry to responsible geologists makes for the most rapid and most economical development of potential oil resources, and that such entry in no way prejudices the interests of the holders of the land. The Australian system of taking up blocks of land without previous survey, and often by the process of marking them off on a map without even visiting the area, would be ludicrous were the effects less tragic." We doubt whether the annals of metalliferous mining history in the continent, wild incidents though they show, can point to more painful examples of that 'get-rich-quick' psychology which has proved so detrimental to sound oil exploration in the past.

Then there is the question of adequacy of geological maps. It is not sufficiently widely understood that in order to get the maximum amount of information of geological circumstances, thus

\* The Parliament of the Commonwealth of Australia. "Report on Tour of Inspection of the Oil-Fields of the United States of America and Argentina, and on Oil Prospects in Australia." By Dr W G Woolnough. Pp 118. (Canberra: H J Green, 1931.) 5s.

to lessen cost of drilling in places foredoomed to failure, months (not days) of careful mapping are necessary. The author rightly enjoins his countrymen that there can be no "really wholesome appreciation of the seriousness of oil search" until such ideas are abandoned.

Thus it all comes down to the fact that prospects are still good, given active, honest, and modern methods. The introduction of overseas capital and technique, under proper and stringent safeguards, is urged. Petroleum will not be won by the 'gold-rush' principle, even if it exists in sufficient quantity to justify the optimism of this

report, but at the same time it seems probable that unless the Government takes another hand in securing unfettered and co-ordinated research for oil in those parts of the continent where the Survey officers consider the most favourable chances to lie, then private enterprise will have to receive a considerable 'boost', either in the form of new financial resources or tempting technical information, before it will move. But when it comes, whether from national or individual impetus, the problem of oil in Australia will at least have been clarified in its main ethical and technical aspects by the publication of this excellent essay.

### Infantile Anæmia and Diet.

THE appearance of a new disease always excites comment, but the disappearance of a common malady may pass without notice. Up to about twenty years ago, a type of simple anæmia, styled 'chlorosis', was prevalent among young employed women in Great Britain. It was easily cured by the administration of iron. To-day, with the improvement in the standard of life of working women, the disease appears to have vanished. Recent investigations have shown, however, that a similar type of anæmia occurs amongst infants, which also can be cured by adding iron to the diet.\* The anæmia is of the so-called 'simple' or 'chlorotic' type, it is characterised by a marked reduction in the hæmoglobin percentage of the blood, without other changes.

The newborn infant is provided with a store of iron in its liver, about two-thirds of that present in the body at birth is laid down during the last three months of intra-uterine life. Thus the premature infant is born with only a small store, although the amount of iron per kilogram body weight is not much less than that found in the full-term baby. After birth the iron store is drawn upon so that by about six months of age it is no greater than in the adult liver. Milk contains little iron, cow's milk less than human. The chief sources in a diet are meat, eggs, and some green vegetables. Examination of the iron stores of newborn animals of different species has led to the conclusion that when an animal is dependent in its early life upon its mother's milk, the iron required for the formation of the hæmoglobin of its blood is supplied from a store in the liver which is laid down during the later stages of intra-uterine life, while when it is capable of fending for itself soon after birth such a store is unnecessary and is not found. The mammalian organism finds it easier to transfer iron from the mother to the child via the placenta than via the mammary glands and the milk.

A nutritional anæmia can be produced in young animals by an exclusive diet of milk, especially if the parents have been maintained on a diet deficient in iron. In the rat, this anæmia can be cured by

the administration daily of small doses of iron together with copper. This observation, which appears well substantiated, may explain the contradictory results which have been reported in the treatment of experimental and infantile anæmias by administration of iron salts. This type of anæmia is not due to a vitamin deficiency, nor is it influenced by light treatment.

Dr Mackay has examined during the past five years 1090 infants and 168 expectant and nursing mothers. The number of hæmoglobin estimations was 4811 on the infants and 315 on the mothers. Part of this work has already been published; the present report refers especially to 174 artificially fed and 230 breastfed infants and 83 mothers. The economic status of the parents of the breastfed babies was slightly better than that of the artificially fed. The fathers were usually small traders or manual workers. The infants were attending the Infant Welfare Department of the Mothers' Hospital of the Salvation Army or the Outpatient Department of the Queen's Hospital for Children. Their ages ranged from 2½ weeks to 13 months. The artificially fed children were given dried milk with a cane sugar addition, and cod-liver oil and orange juice, up to 8 months of age. The breastfed were also given cod-liver oil and orange juice. Weaning began at about 8 months; thereafter a mixed diet was given to both groups. When iron was given to the artificially fed infants it was supplied as iron and ammonium citrate in the dried milk used ("Hemolac"), 31½ grains being added to each pound of milk, so that an infant consuming 1 lb. of milk in the week received 4½ grains of the salt daily. The iron salt used contained a trace of copper, and the dried milk also contained traces of copper and manganese. When mixed feeding was instituted the amount of iron and copper in the diet was considerably increased, since most foodstuffs are richer in these elements than milk. The hæmoglobin estimations were made by Haldane's method, the blood being obtained from a prick on the heel.

The hæmoglobin percentage of the untreated, artificially fed infants showed a sharp drop in the first month of life from the high birth value to about sixty-five per cent at 2-3 months old, a subsequent steady rise to 70 per cent at 5-6 months, and then a continuous drop to 65 per cent at 12

\* Medical Research Council Special Report Series, No. 157. Nutritional Anæmia in Infancy with Special Reference to Iron Deficiency. By Helen M. M. Mackay, assisted by Lorel Goodfellow, with a Statistical Appendix by A. Bradford Hill. (London: H. M. Stationery Office, 1931.) 2s net.



months old. The hæmoglobin curve for the breast-fed babies was similar, though running at a slightly higher level. Iron treatment of the artificially fed infants raised the hæmoglobin level from 3 months of age to about 80 per cent. Other very important observations were that iron treatment approximately halved the morbidity rate, both for diseases of the respiratory and of the gastrointestinal tract, as well as improving the rate of growth. The relatively low hæmoglobin level of the breastfed infants was not due to bacterial infections or nutritional upsets.

The hæmoglobin percentage of the mothers was 75-80, that is, somewhat below the standard for women. The administration of 10-30 grains of iron and ammonium citrate daily before confinement for one to two months had no significant effect upon the hæmoglobin level, when treatment was continued for 6 months after the birth of the infant the hæmoglobin rose about 10 per cent, as compared with a rise of 5 per cent in untreated mothers. The tendency to recovery from anæmia is thus aided by giving iron. No evidence was obtained that this treatment influenced the anæmia of the infants, but it is possible that a longer ante-natal administration might have a favourable effect. Some evidence was obtained that physical immaturity and anæmia in the mother predisposed to anæmia in the child.

Further analysis of the data showed that the greater the rate of growth after birth the more likely was anæmia to develop; babies of small birth weight grow more rapidly than those which are

larger at birth, and anæmia becomes very evident about 6 months of age. The lower the birth weight also the greater is the average drop in the hæmoglobin level within the first 3 months of life. Slight infections do not appear to influence the hæmoglobin, but any severe illness which causes anæmia will hasten the onset of iron deficiency, so that iron treatment is required in the convalescence from such infections.

From the results of this research it is possible to deduce the normal hæmoglobin level in infancy as contrasted with the average level. For the first 3 months the average of the breastfed infants is considered to be the normal, thereafter that of the artificially fed babies supplied with iron. From the curve thus constructed it appears that the hæmoglobin percentage sinks from about 100 at birth to 70 at 2-3 months of age and thereafter rises to 80, this level being reached a couple of months later and being maintained until the end of the first year of life. On this standard about forty-five per cent of breastfed and fifty to seventy per cent of artificially fed infants have a hæmoglobin level ten per cent or more below the normal. The important conclusion reached is therefore that all artificially fed and many breastfed babies should be treated prophylactically with iron for the former a medicated milk is convenient, for the latter a solution of the iron salt in water suitably flavoured can be used. By this means anæmia will be prevented and the incidence of infections will be greatly reduced.

### John Mayow's Place in Chemistry.

AN interesting paper by Prof T S Patterson, entitled "John Mayow in Contemporary Setting: a Contribution to the History of Respiration and Combustion", appears in vol 15 of *Isis* (Feb-Sept 1931). In the course of a comprehensive and fully documented article of 93 pp, Prof Patterson describes the results of a detailed examination of Mayow's "Tractatus duo" (1668) and "Tractatus quinque" (1674), and of contemporary works by Boyle, Hooke, Willis, Lower, Swammerdam, and other authoritative writers of the period upon the subjects of respiration and combustion.

It is evident from the character of this scholarly publication that the author has spared no effort to acclimatise himself in the scientific atmosphere of the Restoration period, so much so, that anyone who reads his critical appraisal of Mayow's work must receive his considered judgment with respect. This is to the effect that modern writers, mainly owing to their failure to go back to original sources, have (1) greatly exaggerated the resemblance of Mayow's views to our own, (2) read into his statements ideas that were not in his mind, (3) credited him with the discoveries and views of others, (4) confused his two works, (5) depended upon what has been written about him, rather than upon what he wrote. "An astonishing piece of special pleading" put forward by

Yeats in 1798 is held responsible for most of the later exaggerations, and among the more recent writers who are quoted as having espoused the cause of Mayow with an unjustifiable enthusiasm are Rodwell (1874), Ramsay (1896), Gotch (1908), Gunther (1921), Singer (1928), Haldane (1929), and Dampier-Whetham (1929).

Thus, in Prof Patterson's judgment, Mayow's "De Respiratione" is a succinct and fairly clear summary of views that had already been published by others, and in other parts of his treatises it is scarcely too much to say that the things that were true were not new, and vice versa. The following reference by Prof Patterson to a passage from a modern historical work may be quoted as a typical criticism based upon his preceding analytical exposition of Mayow's writings.

"In practically every detail this description is entirely erroneous—at least, if we are to understand that everything here attributed to Mayow is to be regarded as having been actually discovered by him—otherwise it has little or no meaning. Mayow was not the *first* to show that a candle enclosed in a flask goes out while there is still, apparently, abundance of air, he was not the *first* to infer that air is heterogeneous, he was not the *first* to suggest the existence in air of a vital substance also to be found in nitre and nitric acid, he was not the *first* to call this substance nitro-

aerial spirit, he was by no means the *first* to show that gunpowder can burn without the assistance of air, he was not the *first* to prove—if he made the experiment at all—that the calx of a metal was heavier than the metal, he was not the *first* to show that an animal placed in a closed vessel died more quickly if a lighted candle was also placed in the vessel. It was not Mayow who *first* suggested that animals exhaust the air of some constituent necessary to life which enters the blood in breathing, and he was not the *first* to infer that this part of the air was the nitro-aerial spirit. And if he was not the first to show or suggest these things, why should he be credited with them? Moreover, he said nothing about combustion in 1669. The only statement which is *partially* correct is that Mayow attributed the increase of weight on calcination of antimony—he did not extend the suggestion to other metals—to combination with igneo-aerial particles, but, as has been shown above, this was merely the adoption of a notion already published by Boyle, and, in addition, since Mayow's idea of

nitro-aerial spirit was very different indeed from our notion of oxygen, it could lead neither Mayow nor his contemporaries any way towards a comprehension of combustion and respiration. Therefore it was ignored, and quite rightly so. Mayow's so-called 'discovery of oxygen' was not forgotten, it was never made."

Prof Patterson has done yeoman service to a cause he has at heart, by undertaking this laborious investigation with such painstaking care. His judgments are severe, but his argued conclusions are bound to impress his readers and help to reshape their conceptions of an important scientific epoch. The appearance of this critical study, long overdue, of Mayow's position among his contemporaries will therefore be welcomed by all students of historical chemistry. A serious study of original sources in this field is not free from drudgery, but we may hope that Prof Patterson's provocative foray into the pre-phlogiston era will induce other chemical historians to burnish their weapons and take the field with (or possibly against) him. JOHN READ

### Obituary.

SIR ALFRED YARROW, BT, FRS

WE much regret to announce the death, which occurred on Jan 24, of Sir Alfred Fernandez Yarrow, the veteran marine engineer and shipbuilder. The son of a clerk in the employ of a West India merchant in the City of London, Sir Alfred Yarrow was born on Jan 13, 1842. Evincing from his earliest years great natural ability, Yarrow attended first a small private school, and then at the age of thirteen years entered University College School, where he had Joseph Chamberlain as a schoolfellow. At the age of fifteen and a half years he was apprenticed to Miller, Ravenhill, and Salkeld, an eminent firm of marine engineers on the Thames, which had been founded by Joseph Miller in 1822 and had gained a high reputation as makers of machinery for mercantile vessels and for warships. One of the contracts completed by the firm during Yarrow's apprenticeship was the machinery for the cross-Channel steamer *s.s. Leinster*, one of four very notable craft running between Holyhead and Dublin, having a speed of eighteen knots.

On the completion of his apprenticeship, Yarrow, having with his friend Hilditch invented a steam plough, became connected with a firm of engineers of Chelmsford, and while acting as their London agent he was able in the course of two or three years to save £1000. Then in 1866, with a partner named Hedley, he set up as a builder of steam boats in a small yard on the eastern side of the Isle of Dogs, close to the Folly Inn, where it is said Charles II. used to pay clandestine visits to Nell Gwynne.

The Thames at this time was the centre of a flourishing shipbuilding industry. Below Yarrow's premises were the yards of Wigram and Green, with a history dating back to the time of Elizabeth, and the famous Thames Iron Works, while above were the establishments of Samuda, Dudgeon and Westwood, and Bailhe, the last of which was taken over by Yarrow in the 'nineties and thus became

the birthplace of some of our early torpedo boat destroyers. Though their first balance-sheets were not satisfactory, the tide of fortune soon turned in favour of Yarrow and his partner, and in the period 1868-75 they turned out no fewer than thirty-five steam boats. In 1875, Yarrow became the sole owner of the concern.

Just as the demand for fast sea-going vessels during the American Civil War had been a boon to the shipbuilders of the 'sixties, so the coming of the torpedo gave Yarrow and his rival, Sir John Thornycroft, whose works were higher up the river at Chiswick, their great opportunity. Beginning in 1873, Yarrow devoted himself to the design of fast steam boats for carrying torpedoes, and at a review at Spithead in 1878 two of his boats, uninvited, accompanied the Queen's yacht from Portsmouth. Though nominally a breach of etiquette, the performance of the boats led the Queen to say they had interested her more than anything else at the review. Six days later the Prince of Wales, afterwards King Edward VII, took a trip in one of them, and it was also one of Yarrow's boats that the present King commanded in 1889.

Though Yarrow's work was not confined to torpedo boats and torpedo boat destroyers, it was with these he achieved his greatest successes. The results of his work, like that of his eminent contemporaries, Thornycroft and Augustin Normand, of Havre, are written in the history of our modern navies. Fast-running reciprocating steam engines, forced draught for boilers, the well-known Yarrow water-tube boiler, superheating, balancing, the use of high tensile steel, and other matters all engaged his attention, and many of his vessels, such as H.M.S. *Hornet* and the Russian destroyer *Sokol*, created remarkable records. The *Sokol* was the first vessel in the world to steam at a speed of thirty knots. In the fifty years, 1868-1918, Yarrow turned out an aggregate of 127,000 tons and a total of 1,700,000 horse power, while his vessels placed end-

to-end would stretch a distance of thirteen and a half miles

Economic factors having made shipbuilding on the Thames unremunerative, Yarrow in 1906 transferred his works to Scotstoun on the Clyde, and it was there that the famous river gunboats for the Tigris campaign were launched

Of Yarrow's public work and his benefactions to the nation it is difficult to speak too highly. A member of the council of the Institution of Naval Architects from 1887, he contributed several papers to its *Transactions* and was always ready to place his valuable experience at the service of others. In 1894 he founded the Yarrow Convalescent Home for Children at Broadstairs. Some years later, at a cost of £20,000, he presented the country with the experimental tank at the National Physical Laboratory at Teddington. He was elected a fellow of the Royal Society in 1922, and in 1923, to mark his sense of the value of research, he made a gift to the Society of a sum of £100,000. In a letter accompanying the donation, Sir Alfred stressed "that the money be used to aid scientific workers by adequate payment and by the supply of apparatus or other facilities, rather than to erect costly buildings". Sir Charles Sherrington's presidential address to the Royal Society that year was devoted mainly to an account of the steps which had been taken to make the fullest use of this and other sums in hand for the benefit of research. It was decided to institute research professorships, to be awarded to workers of proved ability for independent research, and mobile both as regards the university at which they can be held and also as to subject of research. Prof. A. Fowler, professor of astrophysics in the Imperial College of Science, and Mr. G. I. Taylor, fellow and lecturer in mathematics in Trinity College, Cambridge, were appointed to Yarrow research professorships forthwith, and Prof. O. W. Richardson, professor of physics at King's College, London, in the following year. In 1926, Sir Alfred again placed scientific workers deeply in his debt by a gift of £10,000 to the British Association, to be used for general purposes, with the stipulation that it was to be expended, as to both capital and interest, within a period of twenty years. He believed that the present needs of the Association, in its work for science, should receive precedence over provision for the distant future.

With the passing of Sir Alfred Yarrow, the world has lost a great leader of industry, a pioneer of marine engineering science, and a generous benefactor of the cause of scientific study and research.

#### DAME BERTHA NEWALL (née PHILLPOTTS), D B E

WE regret to record the death of Bertha Surtees Newall, more widely known under her maiden name of Phillpotts, which took place at Cambridge on Jan. 21, at the age of fifty-four years. Miss Phillpotts was the daughter of James Surtees Phillpotts, for many years headmaster of Bedford Grammar School. She entered Girton as a student, and took first-class honours in the Medieval and Modern Languages Tripos in 1901. In addition to

the course laid down for her schools, she took up with enthusiasm the study of the Scandinavian languages under Mr. Eiríkr Magnússon. Her College appointed her Pfeiffer student and College librarian, but she resigned in 1910 to study archaeology, acting as secretary to the late Baron A. von Hugel. In 1913 she published her first book, "Kindred and Clan", and was appointed the first holder of the Lady Carlisle fellowship at Somerville College, Oxford. During the War she served as private secretary to the British Minister at Stockholm, perfecting her knowledge of Scandinavian languages and visiting Iceland six times. In 1919 she returned to take up an appointment at Westfield College in the University of London. Here she published her second and best-known book, "The Elder Edda and the Ancient Scandinavian Drama", of which the merit was immediately recognised.

In 1922, Miss Phillpotts became Mistress of Girton College, doing much valuable administrative and organising work for the College, and sitting as the only woman member on the Statutory Commission for the University of Cambridge. The strain of the work and private anxieties led to her resignation, and once more she became a student resident in Cambridge. In 1926 a generous donation of £10,000 from Sweden led to the institution of a School of Scandinavian Studies in the University, for the organisation of which Miss Phillpotts was largely responsible, and of which she was appointed director.

Miss Phillpotts had been made an O B E in 1919, and was promoted to D B E in 1929. She was Litt. D. of the University of Dublin. In 1931 she married Prof. H. F. Newall, professor of astrophysics in the University of Cambridge, 1909-1928.

Miss Phillpotts' published work, scholarly and erudite as it is, scarcely affords a true index of her commanding position in the field of studies she had made her own. Her profound knowledge of the languages, ancient literature, and antiquities of Scandinavia was fully recognised in the north of Europe, where she was regarded as one of the very few outstanding authorities on these subjects.

REFERRING to the death of Prof. E. S. King, on Sept. 10, which was announced in *NATURE* of Nov. 21, Dr. Harlow Shapley, director of the Harvard College Observatory, writes: "Prof. King was astronomer for more than forty years at the Harvard College Observatory. For many years he had been in charge of the photographic work, and had been important therefore in building up the great collection of astrophotographic plates. His own researches were largely in various fields of photometry, and his standards of stellar colour index have been internationally used for many years. In his researches on the colours of the brighter stars he directed attention to the probability that the solar system lies within a thin, nebulous envelope, perhaps only a few hundred light years in diameter, and thus he was the pioneer among the investigators who find the absorption of light in space localised in the local system."

## News and Views.

## Bicentenary of Gabriel Jars.

On Jan. 26 occurred the bicentenary of the birth of the eminent French mineralogist and civil engineer, Gabriel Jars, the author of "*Voyages métallurgiques*", which at the time of its publication was a cyclopædia of information on mining in Europe in the middle of the eighteenth century. The son of a miner, Jars was born at Lyons and became one of the earliest students of the *École des Ponts et Chaussées*, which had been founded in 1747 for the training of engineers for the Government service. Having gained both practical and theoretical knowledge of the art of mining, he was sent in 1757 with Duhamel du Monceau to visit the mines of Europe, with the view of the introduction of improvements into the mines of France. His first tour took him through the central countries of Europe, but afterwards he visited England and Scotland, and the Netherlands and Scandinavia. In 1768 he was admitted a member of the Paris Academy of Sciences, and he was arranging the accounts of his journeys when he suddenly died of sunstroke. His death took place at Clermont on Aug. 20, 1769, when he was only thirty-seven years of age. His brother had accompanied him on his later journeys, and to him fell the task of publishing the "*Voyages métallurgiques*", which appeared in three volumes during the years 1774-81.

## Working-Class Conditions in Bombay

A SOMEWHAT lurid light is thrown upon the effect of industrialism and its attendant conditions on the 'working classes' of Bombay by an analysis of certain statistics published by Dr G. S. Ghurye and S. R. Deshpande in the *Indian Journal of Economics* for October. The statistics were collected by the Bombay Labour Office in co-operation with the Young Women's Christian Association with reference to infant mortality. The number of individuals from whom the particulars were compiled was 2053. The subjects of the inquiry were mainly of agricultural class origin, and mostly from the Konkan. After migration to the city they had usually kept in touch with their place of origin and visited it at least once a year. Their wages are low, they are permanently in debt, and ninety-seven per cent of them live in one-room tenements which are dark and ill-ventilated. The factory hours for mothers range from eight to ten a day. The age-range of the women workers under consideration is 15-45 years and above, the highest percentage, 23.8, lying in the age-group 21-25 years, the next, 22.8 per cent, being in the group 26-30 years. The drop in numbers above twenty-five years of age, which becomes very marked above the age of thirty years, falling to 11.3 per cent, is generally due to the return of the women workers to their place of origin, permanently incapacitated by illness.

The average age of Bombay working women at the birth of the first child is eighteen years, the consummation of infant marriage, usually delayed until some time after puberty, taking place perhaps a little

later on the whole among the workers. It is believed that in Indian women child-bearing ceases early, so considerable time before the menopause, say at about thirty-five years, but inquiry into cases where the family is evidently complete shows that in the workers it takes place at about twenty-eight years. This is supported by further data which show that the average interval between births is 2.8 years, and that the average fertility, taking women more than thirty-five years of age, is 4.4. An examination of the data in the light of these two sets of facts suggests that the figure of twenty-eight years as the close of child-bearing represents a fact and is not due to an accidental selection. The authors consider two features in the statistics disquieting, namely, the early age at which child-bearing ceases and the fertility rate, which is so low in relation to the mortality rate of Bombay city. They point out that there is a danger that the 'working class' of Bombay will fail to keep up its number. To others, however, it may seem that industrial and housing conditions which appear to result in the permanent disablement of a large proportion of the female population at the age of thirty or thereabout even taking into account the early maturity of the Indian woman, and reduces the child-bearing age by seven years, are badly in need of investigation.

## Proposed International Congress of Anthropology

CORDIAL support has been given to the suggestion that a new international congress should be organised to cover anthropology and ethnology. Such a congress would meet the need created by the strict limitation of the field covered by the new International Congress of Prehistory and Protohistoric Sciences, which is to meet for the first time in London this summer. According to a communication from Prof. J. L. Myres which appears in *Man* for January, inquiries made on behalf of the Council of the Royal Anthropological Institute have not only elicited cordial expressions of approval, but also the matter has been taken up actively in Germany by Dr. E. Fischer. As the result of a consultation with his colleagues, he has written recently to the Council of the Royal Anthropological Institute to express the fullest approval on behalf of all the full professors of anthropology in Germany. They express willingness to concur in any arrangements the Institute may make for the formation of an international congress on the lines laid down last May for the Congress of Prehistory. It is suggested that similar statutes and constitution should be formulated, that the congress should be organised in two sections, one for anthropology and one for ethnology, that four languages should be officially recognised for the proceedings, and that meetings should take place at intervals of four years, preferably in the year in which the International Congress of Americanists meets in Europe. Such a date would provide for an alternation with the Prehistoric Congress, which will meet in London in 1932 and, probably, in Oslo in 1936. The first meet-

ing of the Anthropological Congress would take place when the next meeting of the Americanists is held in Europe, that is, in 1934. The Council of the Royal Anthropological Institute accordingly invites the anthropologists of all countries to co-operate in forming such a congress.

#### Isolation of Vitamin B<sub>1</sub>

In the second issue of the *Zeitschrift für Physiologische Chemie* for 1932, Prof. Windaus and his co-workers announce the isolation of the anti-neuritic vitamin B<sub>1</sub> in what appears to be the pure state. In 1926, Jansen and Donath reported the preparation from rice bran of a crystalline substance having the formula  $C_6H_{10}ON_2$ , which was believed to be the vitamin, but subsequent work, notably that of Jansen, Kinnersley, Peters, and Reader, in 1930, showed that the substance was not pure. In 1929, Windaus took up the preparation of vitamin B<sub>1</sub> from yeast, and in the initial stages of purification he followed well-known lines. From the neutralised raw extract he has recently prepared the gold salt, decomposed this with hydrogen sulphide, and from the filtrate isolated the picolonate, which is dimorphous. Analysis of the picolonate gave the surprising result that the vitamin contains sulphur as well as nitrogen; its formula is probably  $C_{12}H_{17}N_3OS$ . The hydrochloride was prepared, its absorption spectrum gave a maximum at 250-260  $\mu\mu$ , and its potency, determined on pigeons, was 1.4-3.3  $\gamma$ , as against 9  $\gamma$  found by Jansen and others for the substance isolated by the original method of Jansen and Donath. Prof. Windaus states his belief that he has now isolated the pure vitamin.

#### Structure of the Cell Nucleus

In his presidential address to the Royal Microscopical Society delivered on Jan. 20, Prof. R. Ruggles Gates reviewed present knowledge regarding nuclear structure, especially in relation to genetics. On the basis partly of investigations in his own laboratory, Prof. Gates believes that the nucleolus contains two substances, one of which enters the chromosomes in prophase and leaves them in the telophase of mitosis, and that the chromosome is a double structure throughout the mitotic cycle, a split of the chromonema occurring in metaphase for separation in the following metaphase. The chromonema is derived by the union of chromosomes in prophase, and during interkinesis the chromosome is represented by a double chain of chromomeres. From the evidence of karyomeres in animal cells, the nucleus is regarded as a compound structure, and it was further suggested that the spindle is also compound, the real unit in mitosis being a chromosome with its surrounding karyolymph, which becomes transformed into spindle fibres.

Prof. Gates discussed the relation of chromomeres to genes, pointing out that we have no real knowledge of why the chromosome behaves as a unit. He suggested that the chromosomes of Protista are undifferentiated along their length, and that genic mutations have led to their gradual differentiation, with

the probable result that genes are of different sizes. The gene is, however, not a representative particle but a physiological unit, the conception being necessitated both by the phenomena of crossing-over and of mutation. Each genic difference affects many or all parts of the body. Estimates indicate that the gene is of the same order of size as virus particles, and some at least cannot be composed of more than a few hundred molecules. The specific attractions which arise between chromomeres in meiosis belong to the level of organic rather than physical phenomena, and are at present wholly unexplained. Such conditions as high and low temperatures may inhibit this attraction, and genic mutations have arisen in which asynapsis occurs in one or in both sexes, leading to pollen or seed sterility. Prof. Gates stated that it is not at present clear exactly where the limitations of the gene theory lie.

#### The Expanding Universe.

In his Friday evening discourse at the Royal Institution on Jan. 22, Sir Arthur Eddington discussed the expansion of the universe. Outside our own galaxy of stars there exists a vast number of external galaxies, each containing many millions of stars, which appear as nebulae. These are to be found running away from us almost unanimously, and the farther away they are, the faster they recede. This effect has been observed up to a distance of more than a hundred million light-years, the speed there reaches 20,000 km. a sec.—as fast as an alpha particle. It looks at first as though the nebulae must have a particular aversion to us, but it is not difficult to see that the recession is the effect of a general expansion of the universe, and is not especially aimed at us. An effect of this kind has been anticipated theoretically. Einstein's law of gravitation contains a term representing repulsive force, which is ordinarily minute and negligible, but at very great distances the repulsion becomes large and overmasters the ordinary gravitational attraction, so that very remote objects tend to scatter apart. The theory, however, does not predict the magnitude of this 'cosmical repulsion', and hitherto it has only been possible to evaluate it from direct astronomical observations of the nebulae. Sir Arthur is convinced, however, that precisely the same cosmical term is concerned in the theory of the atom and supplies the standard which determines, for example, the radius of an atom. So that out of the theory of the atom (without any astronomical observations) we can predict the rate of recession of the nebulae, or alternatively, astronomical observation of the distances and velocities of the nebulae is a method of determining the masses of the electron and proton. Sir Arthur stated that, in his opinion, this astronomical phenomenon of the expanding universe is the main clue by which we can ultimately unravel the mechanism of the atom.

#### The Teleprinter

Speaking at the annual dinner of the Insurance Institute at Birmingham on Jan. 22, Sir Kingsley Wood, Postmaster-General, said that the Post Office hopes to introduce in a few months' time a tele-

printer exchange service. This system will probably be much used in the future by business firms. The new method enables letters, reports, and all kinds of messages to be type-written automatically between the offices of any two telephone subscribers, at any distance from one another. The typist in either office types the message, and it is printed simultaneously on the machine in the other's office. Both subscribers thus get a complete typed record of all the communications exchanged. The message can be sent at the speed at which the average typist works. To safeguard against wrong connexions, the sending subscriber presses the 'Who are you?' key. The distant machine at once transmits back its own exchange and number. The service will be available in London in the spring and in the provinces in the summer. Speaking of the British Industries Fair, Sir Kingsley Wood said that at the Castle Bromwich Section the Post Office would have an exhibit which would be connected with Olympia in London, so that the public could see how the system operates. The Post Office is apparently following out its new policy of advertising. We think this highly advisable, as much ill-informed criticism has recently been directed at it.

#### Pontifical Academy of Sciences

At the inaugural meeting of the eighty-fifth academic year of the Pontifical Academy of Sciences, on Dec 20, it was reported that His Holiness Pope Pius XI, who was present at the meeting, had decided on the erection of a new hall in which the meetings could be held. After the delivery of the president's introductory address, in which the scientific activities of the past session were briefly reviewed, the awards of the assessors on the twelve papers on "Mendel's Law and Chromosomes", submitted in competition for a prize of 10,000 lire, were announced. First place has been accorded to Prof. Paolo Enriquez, of the University of Padua, while the paper of Dr. Fraser Darling, of Edinburgh, and that of Prof. Carlo Jucci are considered worthy of special mention, and are to be published at the expense of the Academy.

A NUMBER of communications were then presented to the meeting of the Pontifical Academy. In a paper on so-called embryos of a foraminifer, E. Dervieux stated that organic remains similar to those described by Prof. De Lapparent in 1925 as embryos of *Logena* have now been found in a deposit dredged from a depth of more than 2000 metres near the Balearic Islands. Inertia of space was discussed by G. Gianfranceschi, and a new Sicilian species of the genus *Amphimallus* Latr. was described by P. Lugioni. Dealing with the subject of physical space, matter, and electrons, P. Giorgi expressed the view that the equations of the new physics have reconciled the photonic and undulatory conceptions, but are not yet definitive, as they take account neither of the equality of all electrons or of all protons, nor of the difference in mass between electrons and protons, and, moreover, do not seem adequately to interpret nuclear physics. An account is given by Neviani of the skeleton of *Globicephalus melas* found some years ago near Ladispoli.

In a note by G. Stein on the total lunar eclipse of Sept. 26—observed under ideal conditions at the Vatican Observatory—it is stated that the most striking feature was the appearance of the blueish luminous crescent, which showed no appreciable asymmetry with regard to the straight line joining the centre of the moon with that of the shadow. This phenomenon was also examined by M. Ananoff and referred to in NATURE of Jan. 23, p. 136. A paper entitled "Independence of Histogenesis and Organogenesis", by S. Ranzi, records interesting results connected with the development of pieces of the embryo of *Septa*. The rock samples and fossils collected by General Nobile in Franz Joseph Land were discussed by G. De Angelis d'Ossat, and the various radiations influencing vegetable tumours were classified by Vincenzo Rivera into those which enhance and those which depress the growth of such tumours. Other communications dealt with the occurrence of *Orbitolina* in North America (A. Silvestri), Insecta orientalia (L. Navàs), the proteases of the acido-proteolytes (C. Gormi), the study of equations by an extension of Abel's problem (Scatizzi), etc.

#### British Museum Acquisitions.

AMONG recent acquisitions by the Zoological Department of the British Museum (Natural History) are three Norwegian beavers and a specimen of the rare squid *Stenoteuthis caroli*, about 6.5 ft. long, stranded at Scarborough. It is interesting to find that the Norwegian beaver is still holding its own. A high percentage of the squids stranded in Great Britain are found on the Yorkshire coast. The Department of Geology has recently been enriched by the presentation, through the trustees of the Vernay-Archbold Expedition, of a large series of fossils collected by Dr. Errol I. White in Madagascar during 1929. The specimens are chiefly those of the sub-fossil fauna which became extinct probably within historic times, for mention of many of the creatures, some of which are remarkable for their great size, occurs in Malagasy folk-tales. Among the interesting specimens are the remains of the extinct Giant Lemur, *Megaladapis*, which has the largest skull of any known primate, and is peculiar in lacking the front cutting-teeth (incisors) in the upper jaw. A fragment weighing 1084 gm. of the rare pallasite type of meteorite of a new find near Alice Springs, MacDonnell Ranges, Central Australia, and various minerals and rocks collected by the donor have been presented by Dr. Herbert Basedow to the Department of Minerals. A large collection of co-types of Chinese species of *Rhododendron* have been presented by the Edinburgh Botanic Garden. These were from collections made by the late Mr. George Forrest, news of whose death in Yunnan reached England only a few days ago. Miss M. Brown has presented the British herbarium of her father, Henry Brown (1824-92). The herbarium was got together mainly while Henry Brown was a pupil of Isaac Brown, of Hitchin, who was a well-known naturalist and Lord Lister's first school-master.



### Breeding of Touracos in England

TOURACOS, of the species first to be made known to science (*Turacus persa*), were bred in England last year by Capt H S Stokes, who gives an account of his success in the *Avicultural Magazine* for January (p 3). The birds, which had made more than one unsuccessful attempt to breed before, hatched a young one in mid-July, which they brooded in turns, the cock taking the day shift, as with pigeons. As with these birds, too, the young was fed by regurgitation, and remained on the nest for some time, but here the resemblance ceased, for it was downy and left the nest and fed itself before it was fledged, with wing-feathers, however, developed, but showing white instead of the characteristic red on the primaries of this bird and its near allies in the touraco family. It was not until the bird was nearly full-grown that this red appeared by a gradual change in the colour of the feathers, this would seem to indicate that the characteristic copper-containing pigment, turacin, cannot be secreted by the young touraco until the demands of bodily growth have been practically met, and apropos of this red colour, it may be mentioned that in old stuffed specimens of touracos long exposed to light it becomes purple. The only species of the family bred here previously is *T. macrorhynchus*, a much less familiar bird, but it often happens in aviculture that the rarer species breed best.

### Luminosity of Fire-Flies.

WE have received a communication from Mr Edward T Dixon, of Billy Dun, Half Way Tree, Jamaica, regarding the luminosity of fire-flies in Jamaica. He mentions having observed large numbers of a species of fire-fly emitting flashes of light in rhythmic unison, a feature, it may be added, that has been noted in other lands. In the Jamaican species the flashes were emitted at intervals of just under three seconds duration. Mr Dixon mentions having seen half an acre or more of a grass field lit up brilliantly by the flashes of fire-flies so that the shrubs and hedges were revealed. During the intervals between the flashes nothing was visible in the prevailing darkness. Little is known regarding the phenomenon, and experimental observations with reference to the co-ordination of light emission by these insects might prove of great interest.

### Centenary of the *Nautical Magazine*

THE *Nautical Magazine* this year commemorates its centenary, and the January issue is therefore devoted mainly to a review of the progress of nautical matters during the last hundred years. The journal was founded in 1832, and edited for thirty-eight years, by Commander (afterwards Rear-Admiral) A B Becher, an officer who served for many years under Beaufort, the hydrographer to the Navy. The original prospectus of the magazine stated that its contents would be arranged under the four heads, hydrography, voyages, navigation, and nautical miscellany, while on his retirement Becher said that the aim of the magazine had been "to aid anything which might contribute to the seamen's benefit." Many eminent men of science have contributed to its pages. The names of Sir John

Franklin, Lieut Henry Raper, Sir W Snow Harris, Lieut M F Maury, James Glaisher, Sir William Thomson (afterwards Lord Kelvin), and Lord Brassey are all to be found among the contributors of the first half of the magazine's career, while in more recent times articles have appeared signed by distinguished officers of both the Royal Navy and the Mercantile Marine. Recognised all over the world as the magazine of the merchant service, the *Nautical Magazine* has faithfully reflected all the aspects of maritime affairs, the scope and interest of which are well illustrated by the series of articles on navigation, ships, education, meteorology, and other subjects in the centenary number.

### Road Traffic Signalling

WE learn from *Roads and Road Construction* for January that upwards of five hundred million pounds has been spent in roads and road construction during the past ten years. It is also stated that the work has neither been scientifically considered nor directed in relation to those chiefly concerned. The special aspect of road traffic signalling was considered at the Institution of Civil Engineers on Dec 9. In opening the meeting, Major Aldington laid stress on the importance of extending the automatic signalling system to highways. This would expedite the movement of traffic and so would lead to economies. In the London area alone, £450,000 is spent annually in the provision of police to regulate the traffic at the points of intersection of roads. The provision of facilities for roundabout working and electric signalling would be a boon to drivers and would materially reduce the number of accidents. The discussion largely centred round the visual signal system adopted in Oxford Street. Some of the speakers suggested that the amber light should be regarded as the signal for pedestrians. Much was said in favour of a gyratory system being adopted in Oxford Circus. It was stated that the abolition of right-angled turns would be certain to make the traffic more fluid. It is also common knowledge that the traffic up Harewood Place, across Oxford Street, is often prevented from moving at certain times of the day, although the green lights are showing, by the crowds of pedestrians in Oxford Street. A model for the automatic control of signals at crossings was shown to the meeting, the signals being operated by the traffic.

### Steam Research in Europe and America.

UNDER this title, Dr Ing Max Jakob last May delivered a course of four lectures under the auspices of the University of London. Constituting as they did a valuable up-to-date review of the experimental work of recent years, the lectures have been prepared for publication since being delivered, and have been printed *in extenso* in *Engineering* in eight sections during July-Dec 1931. The first lecture dealt with the fundamental thermodynamical properties of water and steam, including the mechanical and thermometric direct measurements of pressure, temperature, and volume, the second with the calorimetric, direct measurements of sensible and latent heat contents, the third with the optical measurements by which attempts have been made to determine the specific

heat at high temperature, and the development of the steam tables in different countries, while the fourth lecture was a survey of some special problems of steam research such as evaporation, condensation, heat transfer, and heat radiation. Reference was made to the international co-operation on steam research suggested by the British Electrical and Allied Industries Research Association, while at the beginning of his lectures Dr Jakob paid a tribute to the late Prof H L Callendar, who had, he said, comprehended and mastered the whole science of thermodynamics of water and steam more fully than anyone else in the world.

#### Pendleton Earth-shake of Jan 16.

AT about 12 30 A.M. on Jan 16, slight earth-shakes were felt in the mining district around Pendleton, near Manchester. The intensity was less than usual (degree 4, Rossi-Forel scale). The disturbed area was roughly circular, about four miles in diameter, with its centre close to the line of the Irwell Valley fault, and about two miles north-west of Pendleton. There can be little, if any, doubt that the earth-shakes of this district are caused by slips along the fault due to the withdrawal of the coal or to other mining operations. The chief interest of the recent shocks is that they disturbed almost exactly the same area as one did on Feb 27, 1899. On April 7, 1900, a similar shock occurred with its centre a short distance to the south-east, and on Nov. 25, 1905, and May 3, 1931, much stronger shocks, with their centres close to Pendleton, or nearly two miles south-east of the centre of the latest shock.

#### Announcements.

At the annual general meeting of the Royal Meteorological Society on Jan. 20, the following officers were elected for 1932. *President*, Prof S Chapman, *Vice-Presidents*, Dr C. E. P. Brooks, Mr C. K. M. Douglas, Mr J. Fairgrieve, Mr. R. G. K. Lempfert; *Secretaries*, Dr J. Glasspoole, Mr W. M. Witchell, Dr. A. Crichton Mitchell, *New Members of Council*, Lieut.-Com T. R. Beatty and Mrs C. J. P. Cave.

THE following have been elected officers of the Royal Microscopical Society for 1932. *President*, Mr Conrad Beck, *Vice-Presidents*, Mr A. Earland, Prof R. Ruggles Gates, Mr J. Rheinberg, Dr G. S. Sansom, *Treasurer*, Mr C. F. Hill, *Secretaries*, Mr J. E. Barnard, Prof. R. T. Hewlett, *Hon. Librarian*, Dr Clarence Tierney, *New Members of Council*, Prof D. M. Blair, Mr S. H. Browning, Mr B. K. Johnson, Mr A. More, Mr J. Smiles, Mr H. Wrighton.

THE present programmes of standard frequency transmissions on the first and third Tuesday afternoons of each month from the transmitting station 5 H.W., at the National Physical Laboratory, have now been discontinued. They will be replaced by specially modulated transmissions in accordance with a programme which will be announced at a later date. The three-monthly evening transmission on 1785 Kc/s will be continued as at present. Particulars of this transmission can be obtained from the Department

of Scientific and Industrial Research, 16 Old Queen Street, London, S.W.1.

At the recent annual meeting of the Botanical Society of America, the following officers were elected for 1932. *President*, Prof G. J. Peirce, Leland Stanford University, *Vice-President*, Prof A. J. Eames, Cornell University, *Secretary*, Prof S. F. Trelease, Columbia University. The following botanists were elected as corresponding members. Prof P. A. Dangeard, The Sorbonne, Paris, Prof Ludwig Diels, University of Berlin; Prof H. H. Dixon, Trinity College, Dublin; Prof K. Miyabe, Hokkaido Imperial University; and Prof F. Oltmanns, University of Freiburg im Breisgau.

MESSRS Dulau and Co., Ltd., 32 Old Bond Street, W.1, have just issued a catalogue (No 194) of nearly five hundred second-hand works of botanical interest, obtained chiefly from the library of the Royal Botanic Society of London. The prices asked appear very reasonable.

THE two large catalogues of chemical and physical apparatus issued by Messrs F. E. Becker and Co. (W. and J. George, Ltd.) are well known in laboratories. This firm has now drawn up a 72-page supplementary catalogue on the same lines as the general catalogues, including only laboratory equipment made in Great Britain, and much of it in Messrs. Becker's own works. The reputation of British scientific instruments has grown rapidly in recent years and with it the range and scale of production. As a consequence Messrs Becker are now able to state that, with the exception of furnace-made glassware, porcelain, and similar articles, they are practically independent of outside sources. The present catalogue certainly seems to include all the ordinary equipment of a laboratory.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.—A lecturer in radiology in the University of Liverpool—The Registrar, the University, Liverpool (Jan 31). An assistant medical officer at the Radium Institute, Manchester, for dealing largely with radium and deep X-ray cancer therapy in the Institute and Associated Hospitals—The Hon. Secretary, Radium Institute, Manchester (Feb 2). Two mechanical engineers in the Ordnance Factories, Royal Arsenal—The Chief Superintendent of Ordnance Factories, Royal Arsenal, Woolwich, S.E. 18 (Feb 5). A biochemist at the Selly Oak Hospital, Birmingham—Dr R. P. S. Kelman, Selly Oak Hospital, Birmingham (Feb 10). A sub-editor of the *British Journal of Radiology*—The General Secretary, British Institute of Radiology, 32 Welbeck Street, W.1 (Feb 20). A professor of zoology in McGill University, Montreal, Canada—The Secretary, McGill University, Montreal, Canada (April 1). A lecturer in philosophy at Exeter College, Oxford—The Rector, Exeter College, Oxford (May 14). A Dr Robert Pollok lecturer in materia medica and therapeutics in the University of Glasgow—The Secretary, University Court, the University, Glasgow.

## Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

## Theories of Muscular Contraction

SINCE Lundsgaard showed that the contractile mechanism can work without production of lactic acid and that this acid, when formed, appears mainly, perhaps entirely, after contraction is over, the one remaining important chemical change, the breakdown of phosphagen (phosphocreatine) is generally supposed to precede and cause contraction. This view, however, scarcely accounts properly for the observed behaviour of muscles poisoned with iodoacetate. In such muscles, when stimulated in nitrogen, exhaustion of the phosphagen supply brings to an end the only available exothermic reaction and the muscle fails to respond, but it does not fail to contract, *it fails to relax*, for it remains in a state of contraction ('rigor') developing a tension not far short of a maximal twitch. It seems more natural to conclude that the chemical reactions accompanying activity are primarily concerned with relaxation and occur after contraction, this is to say, they represent stages in a 'recovery process' as that term has been applied to processes in nerve.

When Fletcher and Hopkins had exploded the 'inogen' theory of contraction, it was assumed that the sequence of events must be (1) excitation, (2) an exothermic chemical reaction, (3) contraction. It was therefore supposed that in resting muscle the contractile mechanism (whatever its nature) was at zero energy potential and that the exothermic reaction 'charged up' the system to high potential, thereby producing a structure tending to be of shorter length. Relaxation was the result of dissipating the energy and returning to zero potential. The theory here suggested is the opposite and is a partial return to the 'inogen' theory. In resting muscles the contractile mechanism is supposed to be at a steady high potential, maintained by the resting metabolism. On excitation, the potential falls to zero and the muscle tends to a shorter length. It then relaxes because the contractile mechanism is recharged to its original potential by what is essentially a speeding up of chemical changes occurring the whole time. In quick moving muscles the recharging is begun by the rapid process of phosphagen breakdown, in slower muscles other slower reactions may perhaps replace the phosphagen mechanism.

The terms 'charge' and 'discharge' are intended to suggest the analogy of an electrical condenser. The contractile mechanism may well consist of longitudinally arranged and electrically polarised surfaces. If these are extensible, the repulsive forces of the electric charges will make them longer when charged than discharged. A mechanism of this sort is similar to that generally supposed to be concerned with the excitation process in nerve. However, the main point is quite independent of any particular type of physical mechanism imagined to exist in the muscle and is a matter of the time relations of the chemical reactions.

The theory here suggested, 'Charged at Rest', seems to fit the facts at least as well as the alternative 'Discharged at Rest', and in some cases better. As already mentioned, it gives a more accurate account of the phenomena of the iodoacetate muscle. It provides a function for the resting metabolism and

explains why the metabolism of activity and of rest differ quantitatively rather than qualitatively. Again, it fits in better with the phenomena of the refractory period after excitation. If each excitation discharges the contractile mechanism to zero potential, a second discharge is impossible until recharging has begun, and the second discharge will be smaller than the first until the full potential is reached. On the 'Discharged at Rest' theory there is no reason to expect a refractory phase. Lastly, if, as seems likely, the initial resting state is more unstable the higher the potential, it is easy to see how some muscles can be self-exciting and others not. That is to say, the difference between heart and skeletal muscle is that in the heart the recharging process is slow (long refractory period) but tends to charge the mechanism up beyond the level at which it is stable. In skeletal muscle the recharging is rapid but never exceeds the level at which extra energy has to be provided by an external stimulus to discharge the mechanism.

A. D. RITCHIE

Victoria University of Manchester,  
Jan 8

## Inheritance of Milking Capacity.

A STUDY of the milk yields of the progeny of 728 bulls of the Red Danish breed has been made with a view to determine—first, the ability of each bull to transmit the different degrees of milking capacity, and secondly, having thus obtained an index of this ability, to determine the extent to which it was influenced by the various animals in his pedigree. The average number of daughters to each bull was 18. The figures were taken from the annual reports of the Milk Recording Societies throughout Denmark for 1918–1931. The daughters' yields were mainly calculated on the average of the first two lactations and corrected to the third lactation. The records of the dams and grandams were based on as many lactations as possible, from three to ten, and averaging 5.5. The average of these uncorrected lactations was taken as an indication of the milking capacity of the dam or grandams.

To measure the genetic aspect of the ability of bulls to transmit milking capacity, correlations were made of the average yields of the daughters of these

|                       |          |          | Total Yield of Milk |         |                     | Total Yield of Butter-fat |         |                     |
|-----------------------|----------|----------|---------------------|---------|---------------------|---------------------------|---------|---------------------|
| <i>x</i>              | <i>y</i> | <i>N</i> | <i>r</i>            | $R_y^2$ | $\sigma y/\sigma x$ | <i>r</i>                  | $R_y^2$ | $\sigma y/\sigma x$ |
| Bulls to Sires        |          | 555      | 0.255               | 0.291   | 0.877               | 0.324                     | 0.388   | 0.834               |
| " to Dams             |          | 725      | 0.173               | 0.117   | 1.47                | 0.183                     | 0.141   | 1.30                |
| " to Paternal G'sires |          | 473      | 0.202               | 0.263   | 0.767               | 0.193                     | 0.267   | 0.723               |
| " to Maternal G'sires |          | 505      | 0.194               | 0.208   | 0.932               | 0.258                     | 0.291   | 0.885               |
| " to Paternal G'dams  |          | 721      | 0.026               | 0.018   | 1.45                | 0.061                     | 0.055   | 1.10                |
| " to Maternal G'dams  |          | 715      | 0.112               | 0.077   | 1.46                | 0.170                     | 0.134   | 1.27                |

The standard error of '*r*' ranges from  $\pm 0.03$  to  $\pm 0.04$

*R* = Regression

Bulls (*x*) mean total yield of milk = 4403 kgm,  $\sigma = 440$

" " " of butter-fat = 179.64 kgm,  $\sigma = 20.48$

bulls to the average yields of the daughters of their sires, and to the actual yields of their dams and grandams. Thus the milking capacity of the bulls (as measured by the yields of their daughters) has been correlated to the milking capacity of the sires and grandsires (similarly measured) and to the dams and grandams (as measured by actual production). These correlations are as shown in the accompanying table.

It is to be noted that the genotypes of the bulls have been compared to the *genotypes* of their male ancestors but to the *phenotypes* of their female ancestors. Hence the correlation figures to the male ancestry cannot be directly compared with those to the female ancestry.

It will be seen that as regards milk yield the paternal grandsire has an effect equal with the maternal grandsire, though as regards butter-fat yields the maternal grandsire is of slightly greater importance. This can be accounted for by the methods employed by the breeders, who for the past fifteen years have, through an intelligent appreciation of the value of the progeny test, paid almost exclusive attention to the male line. From a study of the records of the progeny of the two grandsires and the deviation of the yields of their daughters, it was found that the more highly selected bulls which appeared as paternal grandsires were distinctly more homozygous for the factors affecting the transmission of milking capacity than were the less highly selected maternal grandsires.

There is, however, a highly significant difference between the correlation figures to the two grandams. The correlation to the paternal grandam is practically nil, while that to the maternal grandam is significant.

Smith, Scott, and Fowler,<sup>1</sup> working with correlations of Ayrshire cows to their ancestors, found a significantly lower correlation to the paternal than to the maternal grandsire, and from this deduced the possibility that sex-linked factors might be involved. In the present study, the correlation to the two grandsires is approximately the same, but a difference is found between the correlations to the two grandams. The present study is of *bulls* and their ancestry. A character inherited in a sex-linked manner cannot be transmitted to a bull from his paternal grandam. (But a paternal grandam can transmit sex-linked factors to her granddaughters.) Accordingly, in the present work the test as to whether sex-linked factors are involved in the transmission of milking capacity depends on whether or not there is in this respect a difference between the correlations of the bull to his two grandams. This has been found to be the case. Thus, while from these figures it can be demonstrated that autosomal factors are concerned in the transmission of milking capacity, it is also clearly shown that this capacity is to no small extent conditioned by factors inherited in a sex-linked manner.

KARL MADSEN.

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<sup>1</sup> Smith, A. D. Buchanan, Scott, F. J., and Fowler, A. B. "The Inheritance of Milk Yield in Ayrshire Cows", *J. Dairy Research*, 1, 174-179, 1930.

#### Field Studies and Physiology: a Correlation in the Field of Avian Reproduction

ELIOT HOWARD,<sup>1</sup> in his classical field studies on the behaviour of the warblers, buntings, and other passerine birds, has pointed out that whereas the male has what we may call two *phases* of sexual behaviour—neuter and full male—the female has three, for she passes from the neuter phase of winter to full femaleness by way of a partly-sexed phase. During this intermediate phase she seeks out the company of a male, appears interested in various of his advances, and may construct the outer shell of one or several nests. But it is not until the fully-sexed phase that she will solicit or permit coition, or will construct a lining for a nest. The fully-sexed phase begins about 3-6 days before the first egg is laid.

Meanwhile, Riddle<sup>2</sup> and his associates, working

with ring-doves (*Peristeridae*), has found a remarkable set of physiological changes associated with ovulation in the female, and all taking their origin about four and a half days before the first egg is *ovulated* (that is, rather more before it is *laid*). The blood-sugar rises 20-25 per cent, the weight of the adrenals hypertrophies by about 40 per cent; the blood calcium rises about 100 per cent, the oviducts enlarge by about 800 per cent, the histological picture of the thyroid changes from rest to marked activity; the blood-fat goes up by about 35 per cent and its contained phosphorus by about 50 per cent, and the egg (oocyte) itself suddenly begins to grow about twenty-five times as fast as before, and to put on yellow yolk in place of white. Doubtless general ovarian function also alters. All these changes reach their maximum at about the time of ovulation, except those involving fat and phosphorus, the maximum of which is about 2-2½ days before first ovulation.

Very similar changes occur in pigeons (*Columbidae*), the change in growth-rate of the yolk of the egg occurs also in fowls and in ducks (Chomovič<sup>3</sup>), but here 5-8 days before ovulation.

From the facts concerning the onset of changed growth-rate of the yolk in fowls and pigeons, it is clear that the physiological change begins earlier and lasts longer in birds of a large size. In small passerines it would be presumed to begin not more than 3-4 days before ovulation or 4-5 days before laying.

It will, then, be seen that there is evidence of a striking physiological change occurring in certain female birds just about the moment in the reproductive cycle when a striking change in sexual behaviour occurs in other species and it is, I think, legitimate to connect the two. The physiological change is, apparently, chiefly endocrine in nature, involving thyroid, adrenals, parathyroid, ovaries, and presumably pituitary. The correlated alteration in behaviour is of great interest in regard to sexual selection, for if in its absence the female will not permit coition, although the ovary is sufficiently active to induce some interest in birds of the opposite sex, we have an explanation of most of the many records where observers are puzzled by the apparent failure of male courtship-display to attain its end of stimulating the female to coition.

In any event, it seems worth while pointing out this interesting convergence of two quite independent lines of study.

JULIAN S. HUXLEY

King's College,  
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<sup>1</sup> Eliot Howard, "The British Warblers" (London: Poole, 1914), "Territory in Bird Life" (London: Murray, 1920), "Introduction to Bird Behaviour" (Cambridge Univ. Press, 1930).

<sup>2</sup> Riddle, O., references in *Amer. Philos. Soc. Proc.*, 66, 497, 1927, *Endocrinology*, 13, 311, 1929.

<sup>3</sup> Chomovič, G., *Ann. Czechoslov. Acad. Agric.*, 3 (A), 1, 1928.

#### Photoelectrons and Negative Ions.

PROF. WELLISH's recent communication<sup>1</sup> calls for some comment, as he states that the experiments with photoelectric currents in dry air which he describes show that over the range of pressures 7 mm. to 760 mm. "the great majority of negative ions are formed in the vicinity of the electrode at which the electrons originate", a conclusion which is not in agreement with many other experiments made in Sydney and elsewhere.

Some of these experiments are described in the issue of the *Philosophical Magazine* for October 1925, p. 825, where the method used was specially designed to measure the coefficient of attachment  $\alpha$  (Prof. Wellish denotes this quantity by  $\lambda$ ) of electrons which move in a gas at a pressure  $p$  under a uniform electric force of intensity  $X$ .

The values of the ratio  $a/p$  with dry air then obtained have been confirmed more recently in some experiments by a method, yet unpublished, in which the nature of the photoelectric stream is examined at various distances from its source while the pressure and electric force are kept constant. With dry air and several other gases this method showed that for appropriate values of pressure and electric force the nature of the stream changes progressively with the distance from its source.

These experiments were not designed to give information about the formation of negative ions near the emitting surface, but by means of the theory and observations given in 1925 it is easy to calculate an upper limit for the ratio of the number of ions formed initially to the number formed in the gas. Such a calculation shows, for example, that this ratio is less than one in dry air at a pressure of 22.6 mm with an electric force of 10 volts/cm. Moreover, if Prof. Wellish's conclusions be true, it would be practically impossible in any of these experiments to observe the attachment of electrons in the gas.

With regard to the evidence adduced by Prof. Wellish, it is remarkable that the curves *A* and *B* in his diagram are less consistent with his own views than with the theory that negative ions may be formed quite as notably in the gas as near the cathode. This is shown clearly in Table 1, where the observed values of the ordinates  $y_A$ ,  $y_B$  (for the curves *A* and *B* respectively) for different values of the abscissa  $x$  are compared with values calculated on the two theories.

TABLE 1

Constants adopted: mobility  $k=1.8$ ,  $f_A=0.5$ ,  $f_B=0.52$

| $x$  |                          | $y_A$ | $y_B$ | $a$  | $\theta$ |
|------|--------------------------|-------|-------|------|----------|
| 0.01 | Observed                 | 0.49  | 0.35  |      |          |
|      | Theory of attachment     | 0.486 | 0.35  | 0.15 | 0.84     |
|      | Theory of non-attachment | 0.483 | 0.35  | 0    | 0.67     |
| 0.02 | Observed                 | 0.45  | 0.22  |      |          |
|      | Theory of attachment     | 0.448 | 0.22  | 0.20 | 0.60     |
|      | Theory of non-attachment | 0.440 | 0.22  | 0    | 0.42     |
| 0.04 | Observed                 | 0.375 | 0.13  |      |          |
|      | Theory of attachment     | 0.376 | 0.13  | 0.50 | 0.64     |
|      | Theory of non-attachment | 0.344 | 0.13  | 0    | 0.25     |

TABLE 2

| $X/p$               |         |      |       |
|---------------------|---------|------|-------|
| $(a/p) \times 10^3$ | Wellish | 0.85 | 0.424 |
|                     | Bailey  | 2.5  | 3.4   |
|                     |         | 2.1  | 3.1   |

In Table 2 a comparison is made between the values of  $a/p$  thus deduced from Prof. Wellish's experimental results and two values obtained by me in 1925, and this shows good agreement between them.

If the value adopted for the ionic mobility be 2.1, similar calculations show that the theory of attachment in the gas is still in better agreement with the above observed values of  $y_A$  and  $y_B$  than is the other, but less markedly so than is shown by Table 1.

It may then be concluded that for air pressures up to 59 mm the formation of negative ions by attachment of electrons to molecules in the gas is no less notable a process than the formation of negative ions near the cathode.

V. A. BAILEY

Laboratory of Physics,  
University of Sydney, Nov. 9

<sup>1</sup> NATURE, 128, 547, Sept. 26, 1931

### Spectroscopic Evidence of Arsenic Hydride.

Messrs Kimball and Bates<sup>1</sup> have recently described some bands, emitted by a carbon arc, running in an atmosphere of hydrogen. The negative electrode was drilled and filled with arsenic. Because of this, the authors consider the bands to be due to AsH and As<sub>2</sub>. I find, however, strong arguments for the bands being identical with the CH bands  $\lambda 3143$  Å, already investigated by Fortrat<sup>2</sup> and Hori<sup>3</sup>. Even the conditions of activation, mentioned by Kimball and Bates, agree with my conclusions; namely, that the bands were missing when the arsenic was placed in the positive carbon. This can be explained by the fact that the presence of a metal in the positive carbon strongly reduces the temperature of the arc, and the activation of the CH bands is very sensitive for the temperature.

The unresolved band at  $31802.6 \text{ cm}^{-1}$  is surely identical with the *Q* branch in the CH band. The measurements of Fortrat are in good agreement with this, as well as with the values calculated from the formula of Kimball and Bates. In Hori's measurements a constant error appears, owing to the low dispersion used by him. Mr T. Heimer, photographing the CH band in the second order of the 6.5 m concave grating in this laboratory, also finds this error in Hori's measurements.

Directly repeating the experiments of Kimball and Bates, I find no signs of a band spectrum due to AsH.

RAGNAR RYDBERG

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<sup>1</sup> NATURE, 128, 969, Dec. 5, 1931  
<sup>2</sup> C. R. Acad. Sc., 178, 1272, 1924  
<sup>3</sup> Z. Phys., 59, 91, 1930

### The Spinning Photon and its Scattering by Molecules.

THE observed fact that a molecule in scattering light may change its state of rotation, itself conveys the suggestion that the photon has an intrinsic spin, the alternative explanation of a conversion of the linear momentum of light into the angular momentum of the molecule during the collision being *prima facie* highly improbable. The suggestion gains strength when we notice how simply the conception of the spinning photon explains both the selection rules in Raman scattering and the accompanying phenomenon of the reversal of circular polarisation. Nevertheless, to the critically minded, such considerations may fail to carry complete conviction. The reality of photon spin is, however, established<sup>1</sup> by quantitative studies of (1) the intensity of the lines in the rotational Raman spectra of gases, (2) the depolarisation of the Rayleigh scattering when separated from the rotational scattering. The Kramers-Heisenberg theory of dispersion as developed by Mannebeck<sup>2</sup> fails to give correct results on both of these points, while a modified theory based on the concept of the spinning photon meets with complete success.

A further test of the theory of the spinning photon is furnished by quantitative studies of the state of polarisation of the vibration lines in Raman spectra. In certain simple cases, it is possible to associate these lines with linear modes of the vibration of the molecule. Each such vibration line should be accompanied by faint rotational companions on either side of it, the ratio of the intensity of which to that of the parent line is determined by the state of polarisation of the latter. The change in the depolarisation of the Raman line, when measured with a Nicol and a spectrograph, using alternately a very wide and a very narrow slit, enables this ratio to be determined. As

an example, we may mention the case of the strongest vibration line in the spectrum of liquid carbon disulphide. Careful measurements, using a pointolite mercury lamp and photographic photometry, indicate the depolarisation of this line with a fine slit to be 18 per cent. Manneback's theory indicates that the depolarisation should increase, when a very wide slit is used, to 44 per cent, while the theory of spinning photons gives it as 26 per cent. The latter is in close agreement with the observed value, which is 25 per cent.

It is well known that some vibrational Raman lines show very large depolarisation. Bar<sup>3</sup> and Hanle<sup>4</sup> have observed that such lines exhibit the phenomenon of reversal of circular polarisation. In terms of the theory of photon spin, we must assume that in such cases the molecule takes up angular momentum from the incident light in some manner otherwise than by its rotation as a complete entity. Internal spins or rotations within the molecule associated with such modes of vibration have to be postulated. The familiar example of a vibrating string or rod which describes circles or ellipses may help in picturing this state of affairs.

S. BHAGAVANTAM

210 Bowbazar Street, Calcutta,  
Dec. 13

<sup>1</sup> *Ind J Phys*, vol 6, p 353, 1931

<sup>2</sup> *Z Phys*, vol 62, p 224, 1930

<sup>3</sup> *Helv Phys Acta*, vol 4, p 130, 1931

<sup>4</sup> *Naturwiss*, vol 19, p 375, 1931

#### Behaviour of Pyroelectric Crystals.

IN some simple demonstration experiments using liquid air we repeated many of the interesting observations reported by L. Bleekrode<sup>1</sup> and by Miss M. E. Maurice<sup>2</sup> on the demonstration of electric lines of force around pyroelectric crystals. As these papers may have escaped the notice of some mineralogists and crystallographers, we feel it may be helpful to direct attention to what, in our estimate, is the simplest and most striking way of demonstrating the phenomenon of pyroelectricity.

As it came to our notice that at least some mineralogists have considerable difficulty in showing this phenomenon by the well-known method due to Kundt, which consists in dusting finely pulverised red lead and sulphur over the crystal as it cools, we employed this process, taking all the precautions mentioned by Dana<sup>3</sup> to ensure success. Although Dana refers to this method as "very convenient and simple", we consider that Bleekrode's method, in which the low temperature of liquid air is utilised, has advantages over it in this respect. Further, our experiments, using Kundt's method, did not show the effects predicted at all clearly; in fact, we obtained convincing results only in certain simple cases, for example, with a long tourmaline crystal possessing one polar axis.

In contrast to this, the behaviour of a crystal after immersing it in liquid air leaves no doubt as to its pyroelectric nature. The directed growth of the whisker-like ice filaments which form on the polar surfaces of pyroelectric crystals as they warm in air is striking, especially when viewed through a low-power microscope. The shooting off of portions of the ice filaments along the lines of electric force is most marked about a minute after these crystals begin to form. Although we observed the phenomenon clearly with tourmaline and quartz, it was best shown by a small boracite crystal with cubic, rhombic, dodecahedral, and positive and negative tetrahedral faces. Clouds of small ice projectiles passed during a limited period between one set of tetrahedral faces

possessing a positive charge and the other negatively charged set. Even with a tourmaline crystal about 4 cm long, small particles were shot from one pole to the other. By means of an electrified rod, it was easy to show the nature of the poles with this crystal.

In her paper (*loc cit*) Miss Maurice described a new method for measuring the electric moment of a tourmaline crystal, in which the crystal was deflected by an electric doublet. We made an approximate determination of this quantity simply, by suspending the crystal from a single silk thread and then determining its period of vibration in the uniform electric field existing between two large parallel plates in air. In two successive trials the electric moment obtained was 31.3, 31.6 esu and the charge on each end 11.2, 11.3 esu, the crystal having cooled after being discharged in each case through about 150°C. The minimum period occurred after twenty minutes' cooling, and it was used in the calculation. As no special precautions were taken to prevent leakage from the crystal, the absolute values have little significance.

My thanks are due to Mr C. A. Jarman for assistance with these experiments, and to Prof W. N. Benson, who lent the crystals.

CHARLES M. FOCKEN

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<sup>1</sup> L. Bleekrode, *Ann Phys*, 12, p 218, 1902

<sup>2</sup> Miss M. E. Maurice, *Proc Camb Phil Soc*, 26, part iv, p 491, 1930

<sup>3</sup> E. S. Dana, "A Text-Book of Mineralogy", 3rd edition, p 307

#### Microscopic Cracks produced by Electric Spark.

IF a thick electric spark is made to glide along the surface of a piece of an ordinary window glass, a faint trace of the spark track is left on the glass surface. On examining this track under microscope, we find a large number of hair-like cracks running

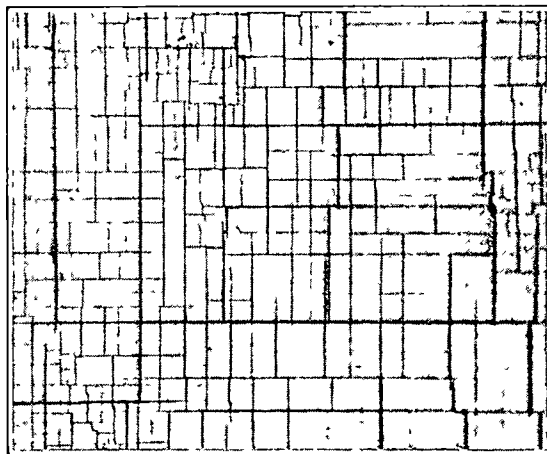


FIG. 1.—Cracks on a cleavage surface of rock salt crystal produced by repeated sparking. Spark length, 3 cm., capacity 15 m.  $\times 150$

roughly parallel to each other and transverse to the axis of the track. It is interesting to observe that the cracks undergo further development even if left undisturbed. Minor secondary cracks gradually appear, filling up the space between the primary cracks with complicated networks. A thin surface layer bounded by these cracks begins to be peeled off, showing thus a mosaic of Newton rings. This latter pattern becomes visible an hour after the sparking and is most marked along the middle zone of the track.



Using a cleavage surface of rock salt crystal instead of the glass surface, a fine pattern of rectangular cracks is obtained (Fig 1). Other crystals give different but characteristic patterns, though not always coinciding with the usual cleavage cracks. The breadth of the zone of cracks increases with the capacity of the spark circuit. The relationship between the density of cracks and the capacity and the potential difference is not simple. The appearance of the cracks is probably due to the electrostatic stress acting as a superficial tension along the spark track. It seems that the present phenomena may be utilised for measuring the steepness of the potential gradient along the spark track.

Details of the results of experiments will be published later in the *Scientific Papers* of our Institute.

TORAHIKO TERADA,  
MORISÔ HIRATA  
RYÛZÔ YAMAMOTO

Institute of Physical and Chemical  
Research, Tokyo

### Character of Atmospheric Ionisation.

IN recent months an apparatus has been set up at Kew Observatory for investigating atmospheric ionisation. A continuous record is taken of the ionisation currents to the central electrodes of three cylindrical condensers, through which air is aspirated. The outer cylinders of the condensers are maintained at three different voltages, which are automatically reversed in sign every five minutes, so that positive and negative ions are alternately collected by the central electrodes. The ionisation currents are recorded photographically on bromide paper by light reflected from the mirrors of three Dolezalek electrometers. The mouths of the condensers project through the wall of a hut and are 10 cm apart from each other. The mean height above the ground, a grass lawn, is 1.5 metres.

A quite unexpected phenomenon has been observed on the photographic traces. So far as can be seen, the ionisation current consists of a succession of pulses which occur simultaneously on all three current records. The magnitude of the effect varies with atmospheric conditions and from one pulse to the next. About twenty such pulses are recorded by the electrometers in each four minutes of charging up, that is, the frequency is five per minute on the average. In fine weather conditions, each electrode collects about  $10^8$  ions in four minutes, so that each pulse contains on the average about  $5 \times 10^6$  ions. Further, a proportionality exists between the pulses on the three instruments, a large 'kick' on one electrometer is accompanied simultaneously by large 'kicks' on the other two.

The Dolezalek electrometers are not critically damped, so it is impossible at the present stage to make accurate measurements of the succession of electrometer 'kicks' which constitute for the most part the current traces. It is intended to utilise a Lindemann electrometer, which is practically dead beat, for obtaining more exact information on the nature and magnitude of the pulses.

The results can only be interpreted as evidence that the ionisation in the bottom layer of the atmosphere is by no means uniformly diffused. Parcels of relatively highly ionised air are present which are of such a size that when one condenser receives a charge-pulse so do the other two. It is not possible to give the number of ions comprising a parcel, one can only point out that the fraction which each condenser collects may be from  $10^6$  to  $10^7$  ions. For comparison, we note that an  $\alpha$ -particle produces about  $2 \times 10^6$

pairs of ions in its path through air at atmospheric pressure, each parcel of ions in the atmosphere probably contains about a thousand times this number.

The phenomenon is yet to be explained, but one feels that the picture it has suggested of ions in parcels distributed more or less regularly through the atmosphere must modify considerably our ideas in atmospheric electricity.

P A SHEPPARD

Kew Observatory,  
Richmond, Surrey,  
Dec 21

### Polish on Metals.

SIR GEORGE BEILBY<sup>1</sup> attributed the polish on metals to the covering over of the surface by a layer of amorphous metal resulting from rubbing, which causes the metal to flow and then harden as a supercooled liquid. Prof G P Thomson's high-speed electron beam camera<sup>2</sup> was used to investigate this.

Small blocks of copper and silver were etched and pictures taken which showed diffraction rings corresponding to the spacings in the cubic lattice of each metal. The copper block was rubbed successively on emery papers No 00, No 000, and No 0000, with benzene as a lubricant to prevent the abrasive from being forced into the metal. At this degree of polish the diffraction rings were diffuse but of the same atomic spacings. As crystals normally give sharp diffraction patterns, the rubbing must have decreased the original size of the crystals, which reduced their resolving power and so caused the rings to broaden.

After polishing with light magnesium oxide and water, the mirror-like surface gave only two broad diffraction rings in place of the previous diffraction rings. The spacings of the copper atoms were now different from those in the crystal structure. The copper atoms must have been flowed into a random arrangement different from their orderly positions in the cubic lattice. But the atoms can approach each other only to a finite distance which will predominate, so that this new semi-orderly arrangement will be favourable for electron diffraction interference.

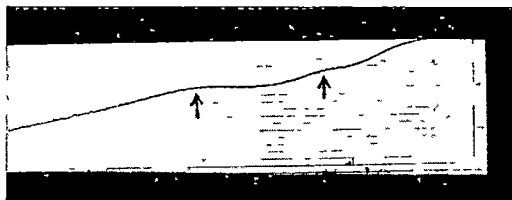


Fig 1

The intensity of the diffracted electrons  $I$  depends on the factor  $\psi$ , the amount that a single copper atom diffracts as the angle of incidence varies, and on the factor  $x$ , a function of the distance between the copper atoms, the angle of incidence, and the wave-length of the electrons  $I = 2\psi^2(1 + \sin x/x)$ . A microphotometer record of the two broad rings from polished copper is shown in Fig 1.

### NEAREST DISTANCE OF APPROACH OF ATOMS

|        | Calculated from<br>diffraction expts | In normal crystal<br>(X-rays) |
|--------|--------------------------------------|-------------------------------|
| Copper | $2.585 \times 10^{-8}$ cm            | $2.54 \times 10^{-8}$ cm      |
| Silver | $2.718 \times 10^{-8}$               | $2.876 \times 10^{-8}$        |
| Iron   | $2.667 \times 10^{-8}$               | $2.78 \times 10^{-8}$         |

These broad rings also appeared from a stainless steel mirror classed above as iron, and from silver and

copper polished with rouge and water. Some specimens were washed in absolute alcohol, others in benzene, and others in water before being photographed. When rouge was used without a quantity of water it became embedded in the metal surface, as shown by Mr B K Johnson using an immersion microscope, and also by the diffraction photographs showing the normal crystal pattern sharply plus additional rings given by the rouge.

R C FRENCH

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<sup>1</sup> Sir G T Beilby, "Aggregation and Flow of Solids"

<sup>2</sup> G P Thomson, *Proc Roy Soc, A*, 128, 1930

### Magnetism of Precipitates of Colloidal Silver.

In a series of contributions <sup>1</sup> it has been shown by us that the magnetic properties of graphite, antimony, bismuth, and gold are modified by colloidalisation.

We have recently investigated two forms of colloiddally precipitated silver. In one method, a dilute solution of silver nitrate was reduced by tannin after adding sodium carbonate. In the second, a dilute solution of the same salt was reduced by hydrazine hydrate. The colloids were coagulated, washed, and dried in vacuum desiccators, precautions being taken to avoid oxidation and impurities. In the former method the specific susceptibility of two specimens was  $0.166 \times 10^{-6}$  and  $0.133 \times 10^{-6}$ , in the latter method, one specimen had a specific susceptibility of  $0.166 \times 10^{-6}$ . (The specific susceptibility of silver in the massive state is  $0.2 \times 10^{-6}$  at atmospheric temperature (I.C.T.)) The maximum size of the particles was about  $10\mu$ . Further attempts are being made to grade the particles and obtain more accurate information.

The hypotheses suggested in the note <sup>2</sup> on a similar phenomenon observed in the case of gold are also applicable to silver. Gold and silver are known to possess paramagnetic atoms, but build up diamagnetism only in the massive state. Changes depending on their crystal and block structure can therefore be expected in them.

V I VAIDHIANATHAN  
B S PURI

Forman Christian College,  
Lahore, Dec 5

<sup>1</sup> See V I Vaidhianathan and Balwant Singh, *NATURE*, 128, 302, 1931, and earlier references there.

<sup>2</sup> See also a later communication to *NATURE*, 128, 153, 1931, by S Ramachandra Rao, where the work on graphite, bismuth, and antimony has been repeated by him, confirming the previous results.

### Photosynthesis of Carbohydrates *in Vitro*.

In a recent paper on this subject, <sup>1</sup> unsuccessful attempts by me to repeat the work of Baly <sup>2</sup> were described. It was not mentioned, however, that consideration had been given to the possibility of the failure to detect any photosynthetic sugars being due to the adsorption of these sugars on the large surfaces exposed by the catalyst powders. The catalysts were, in fact, repeatedly examined for the presence of any organic matter. The kieselguhr supported catalysts and the nickel carbonate were, after use in the photosynthetic tests, heated for some hours with water, and also with absolute alcohol, under reflux. On subsequent evaporation of the water or alcohol, no organic residue was obtained. Tests for charring with concentrated sulphuric acid on the catalysts gave negative results.

In addition, estimations of organic carbon were made, by the method described, on the nickel carbonate after use as a catalyst, but no trace of organic matter was found. Control experiments in which sucrose was estimated in presence of nickel carbonate

showed that the latter did not interfere with the carbon estimation even if present to the extent of 40-50 times the weight of carbohydrate.

JAMES BELL

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University College, London, W C 1

<sup>1</sup> *Trans Far Soc*, 27, 771, 1931

<sup>2</sup> *Proc Roy Soc, A* 116, 197, 1927 *Trans Far Soc*, 27, 545, 1931

### Growth Curves of the Gramineæ

In my paper read at the Belgian Congress National des Sciences at Brussels in 1930, I gave a short account of my measurements of the growth-energy of *Triticum vulgare*, *Hordeum vulgare*, *Secale cereale* and *Avena sativa*, in accordance with growth (velocity) curves in general. I followed accurately each day at the same time, all shoots which issued from one single seed. The curves plotted on rectangular co-ordinates always gave a straight line between the points of inflexion (arithmetical series), and the Archimedes spirals constructed revealed for each kind of plant, during the whole of its life, two distinct growth-waves.

New experiments with the same and other Gramineæ have given the following results: the straight line between the points of inflexion is confirmed, the shoots are interdependent on one another and, in determined order, variable for each individual. For example, numbering the successive shoots of a given *Avena* type, shoot 2 issued from shoot 1, shoot 3 from shoot 2, 4 from 3, 5 from 4, 6 from 5, 7 from 3, 8 from 7, 9 from 6, 10 from 8, and so on, all 195 shoots finally being noted in a table of reference, with their order numbers, in two separate groups. The roots are in accordance with the corresponding grouping of the leaves, this being directly visible by careful carding of them. Plotting all curves of one sample of a complete individual on rectangular co-ordinates in chronological order, one sees, following the tops two or more distinct, regularly ascending-descending lines, that is, the pointed growth-waves of the above. From the beginning to the end they mark characteristic sines and cosines (tangents), and their distance apart again show successive agglomerations or groups from birth to death. A detailed account will be published later in *Roux' Archiv*.

M C SCHUYTEN  
Institut des Hautes Études de Belgique,  
Antwerp, Dec 23

### Esperanto in Scientific Literature.

FOLLOWING Mr Morris-Owen's letter in *NATURE* of Dec 5 regarding the use of Esperanto in scientific literature, readers who are interested, as I am, in meteorology, may like to know that, for several years the Aerological Laboratory of Tateno (Japan) has issued its yearly reports in Esperanto. These volumes containing on an average some 250 pages, 9 in. x 12 in. with many tables, diagrams, and maps, place at our disposal a wealth of information on local meteorological data, to which it was almost impossible for us to get access previously. This example was followed a couple of years ago by the Meteorological Office of the Trans-Siberian Railway, at Karbin: the translation into Esperanto is given by the side of the Russian text, which is a boon to the majority among us, who have found it much easier to master Esperanto than Russian. This year, the Institute of Meteorology and Geodynamics of Ljubljana (Yugoslavia) has followed suit, and I gather that similar institutions are considering taking the same step.

T J GUERITTE

Members Mansions,  
36 and 38 Victoria Street, S W 1, Dec 12

## Research Items.

**Ancient Gold and Enamel Work from Cyprus**—Mr L H Dudley Buxton describes in *Man* for January a remarkably fine piece of ancient gold and enamel work, found, it is said, with two bronze tripods and a fragment of a large bronze vessel by a peasant while digging at Episkopi, the ancient Curium. Unquestionably the bronzes were of Mykenæan age, but it is uncertain what reliance can be placed on the story that all the objects were found together. The object is 17cm in height and consists of a hollow cylinder of gold surmounted by a cloisonné sphere, on top of which stand two birds, almost certainly hawks. The cloisons on the sphere are formed by semi-circular bands in rows one above another. The colours are alternating rows of white, lilac, and green. The body feathers of the birds are similar but smaller scales, the wings and other large feathers are indicated by long parallel stripes. Mr Buxton's descriptive note is followed by a discussion of the dating by Mr S Casson. In default of positive evidence the period must be established by technique, colour, design, and style. The object has no parallel. The method of representing and distinguishing the feathers is derived from the East and first appears on Hittite sculpture in a modified form on the Sindhul sphinxes. It is not found in Egyptian goldwork, but it continues into Hellenic art, mostly in metal-work, and lasts into Byzantine times. The clue to the dating lies in the enamelled scales, which resemble very closely the incised coloured scales common on proto-Corinthian pottery. The application of enamel to cloisons in gold jewellery was not uncommon in the sixth, fifth, and fourth centuries B C, but this example seems the earliest known. It can scarcely be later than the sixth century B C and probably belongs to the early part of that century. Prof J L Myres adds a note in which he suggests the possibility of an earlier dating, pointing out the affinities of the treatment of the plumage and the wings, which exhibit features found in Phœnician, Hittite, and early Greek work. He recognises, however, that the earlier dating isolates the object as a piece of enamel technique. The object is figured in a coloured plate.

**Diorite Axes from Ireland**—Two remarkable diorite axes from Rathlin Island, Co Antrim, have been described by Dr Marcel Baudouin and Mr C Blake Whelan (*Bull Soc Préhist française*, 1931, No 10). Their peculiar character, which is of particular interest to French archæologists, lies in the fact that they differ from the 'diorite axes' found in Brittany and Vendée and resemble the Campignian 'flaked axes' of flint. One of them shows no signs of polishing, and may be compared with specimens of the middle Campignian, or Estrelhan, while the other is polished only at the base of the cutting edge, this bringing it into relation with the Jablmanian, the period of the introduction of polishing. The method of manufacture—by striking off large flakes—differs entirely from that of the polished flint axe, in the preparation of which a large number of very small flakes was struck off. It is evident that, like the Campignian axes of France, the Irish were made without any intention of subsequent polishing, and the size of the flakes is responsible for the irregular character of the work in the partly polished axe. It is to be noted that the fine grained diorite of Brittany and Vendée, unlike that of Ireland, is not suitable for flaking, but was worked by pecking, as is shown by incomplete specimens. It is evident that the two axes here under consideration come from the same workshop. The method of working is identical, except that the one which is partly polished has a number of fine retouches along the edges. The resemblance to the

'haches plates' in flint of the Paris basin is marked. It is concluded (1) that there are diorite axes which were worked by flaking, a fact not yet admitted in France, (2) that there are diorite axes of Campignian facies which are partly polished, and that in a manner differing from that found in France, and (3) that this technique required a special kind of diorite.

**Migration of Birds at St Kilda**—The first-fruits of an interesting natural history expedition to St Kilda carried out in the late summer of 1931, by T H Harrison and a party of enthusiastic undergraduates, appear in a short account of the early autumn migration of that year (*Scot Nat*, p 3, 1931). The visit lasted for three weeks, up to Aug 13, and the observers had the advantage of seeing the arrival of the forefront of the autumn migration, which had passed on before Dr Eagle Clarke landed on either of his prolonged visits. As a result, the composition of the migrant groups was somewhat different from that seen by Dr Clarke. The largest movements were those of waders, but, on the whole, there was a scarcity of those species which breed in high Arctic latitudes and apparently follow the natives of lower altitudes in migratory succession. Few of the migrants seen stayed more than a few days on the island. The list includes twenty-two species.

**Herring Behaviour**—In the *Journal du Conseil Permanent International pour l'Exploration de la Mer*, vol 6, No 2, 1931, Mr Michael Graham makes an original contribution to the study of the problems of herring behaviour. By collecting ideas from fishermen and observing at sea with the drifters, the author attempted to find out how and why the herring get into the nets. It is generally agreed that the entanglement of the fish in the net is due to some sudden concerted movement on the part of the shoals, known by the fishermen as a 'swim'. Mr Graham collected observations on the time, area, and directions of these swims. So far as information can show, the swims appear to be limited in area and to have a definite direction, that there are certain hours when the swims predominate seems certain. It is suggested that normally the herring can see the net, but that a shoal is subject to crowd psychology and will act concertedly under the influence of such factors as panic, sexual excitement, and migratory impulse; under such conditions the fish would be unable to avoid the net. The author records a number of fishermen's beliefs and discusses them in the light of his hypothesis. It is to be hoped that this very interesting work on the habits of the herring will be followed up.

**Storage and Transport of Fruit**—The Empire Marketing Board has recently published two reports on the deterioration of fruit during transit by sea. "Australian and New Zealand Fruit Shipments" (E M B No 46, H M Stationery Office, 1s net, pp 64, Nov 1931) is a report by the Economic Section of the Board of a five years' survey covering investigations in the Dominions and at the docks of Great Britain. Inquiry was directed along four main channels—over-ripeness, fungal rotting, internal breakdown, and bitter-pit. The first two causes of deterioration are aggravated by too high a temperature in the ship's hold. Two types of internal breakdown are described, one associated with low temperature and the other with late harvesting. Bitter-pit has been shown to be more extensive in early than in late picked apples, and more severe in fruit from trees bearing a light crop. The report emphasises the need for a uniform temperature during shipment, not too high to over-ripen or cause fungal

rotting, nor too low to cause deep scald or internal breakdown. The need for quicker handling of fruit consignments after arrival at British docks is also suggested. The other report is entitled "Transport and Storage of Bananas with special reference to Chilling", and is by Dr C W Wardlaw and Dr L P McGuire (E M B No 45, H M Stationery Office, 1s net, pp 37, Nov 1931). It deals chiefly with main stalk rot of bananas (*Thielaviopsis paradoxa*), finger stalk rot (*Gloeosporium musarum*), and fruit rot (*Botryodiplodia theobromæ*), and shows how these diseases can be overcome by rapid chilling of the cargo to 53° F. This temperature is low enough to curtail fungal activity and high enough to allow adequate ripening. Pre-storage and nutritional factors also influence the fungal rotting.

**Ensilage**—Ensilage has now become an important part of agricultural practice in the British Isles, and an up-to-date account of the subject is to be found in Bulletin No 37, issued by the Ministry of Agriculture as a revised edition of their Miscellaneous Publication, No 53 (London H M Stationery Office, price 1s), by A Amos and H E Woodman. Although the making of silage from succulent green fodders is recorded in 1843, the first attempts to introduce the art into Great Britain were but temporarily successful, and it was not until 1910 that any consistent advance in its production was made. The operation is not difficult, the crops are easy to grow, require less labour than roots, and can conveniently be cut between hay and corn harvests. In addition, silage has a high feeding value and will keep for a long period without deterioration. Several distinct forms of silage can be obtained according to the conditions under which it is produced, the quality can also largely be controlled. Although most herbaceous plants are satisfactory for conversion into silage, certain points should be observed in making a selection of the most suitable crop. The three chief methods of silage making are by means of tower silos, clamps, and stacks. Full details, including any necessary precautions, are supplied for each method. The chemistry of silage and the changes that occur in the plant while it is in the silo are also fully discussed, and a comparison of the results of feeding experiments with silage, the fresh green crop, and other commonly used food-stuffs shows that it can be used with advantage for many classes of stock.

**Ganometric Method of Measuring Geological Time**—Prof H Fairfield Osborn, with the assistance of Mr. E H Colbert, has published in the *Proceedings of the American Philosophical Society*, vol 70, No 2, 1931, a preliminary notice of a method of measuring time in its geological aspect. This method, which is termed the 'ganometric', has been arrived at from a close examination and comparison of the enamel folds in the posterior molar teeth of the many genera and species of elephants. It has been found that the total length of enamel, when measured along the folds, shows a definite increase in course of time. The rate of increase seems to vary in different phylogenetic lines, being rapid in some and slow in others. More detailed investigation into this interesting suggestion is in progress, and, if the thesis can be proved true, it will form a very useful test of the age of deposits and in addition will be most useful in helping to date such human remains and artefacts that may be found, as they sometimes are, in the same levels as proboscidean remains.

**A New Canadian Uraninite**—In 1930 uraninite was discovered in pegmatite on the Huron claim, Winnipeg River area, south-east Manitoba. Selected material has now been analysed by H V Ellsworth, and the results appear in the *American Mineralogist* for December 1931 with a general account in which

J S DeLury collaborates. The figures for age calculation are as follows

|                           |       |       |
|---------------------------|-------|-------|
| U                         | 53 50 | 55 01 |
| Th                        | 12 46 | 12 25 |
| Pb                        | 15 44 | 15 50 |
| Pb                        |       |       |
| $\bar{U} + 0.38 \bar{Th}$ | 0 265 | 0 260 |

The very high lead-ratio makes this the oldest uraninite yet discovered, and in view of this surprising result, it is of importance to notice that the authors add, "There is not the least suspicion that galena or any other foreign minerals were present." The ratio is approached only by that of the Ingersoll, South Dakota, uraninite (0.225) analysed by C W Davis. The Manitoba uraninite occurs in pegmatites that cut the Rice Lake series, which is lithologically similar to the Keewatin-Couchiching rocks of Ontario. If the age indication of the lead-ratio is accepted, the pegmatites must be very much older than those cutting the Grenville series in Ontario and Quebec, for which the corresponding ratios lie between 0.15 and 0.16.

**Measurements on Isotopes**—A number of new measurements on isotopes with the mass-spectrograph have been described by Dr F W Aston (*Proc Roy Soc*, Jan), which provide, as usual, a useful check upon the chemical values of the atomic weights. Caesium, for which the accepted chemical value is 132.81, has been found to have the distinctly higher atomic weight  $132.92 \pm 0.02$ . For strontium the positive ion value is  $87.64 \pm 0.06$ , in excellent agreement with the chemical value 87.63. For rubidium and thallium the chemical and electrical values are also in good agreement, although for the latter element Hönigschmid's number 204.39 is preferred to Briscoe's more recent 204.34. Barium ( $137.43 \pm 0.08$ ) also agrees reasonably well with the chemical determination, but for scandium Dr Aston's value is  $44.96 \pm 0.05$ , which is lower than the chemical value, 45.1, suggesting that the latter needs revision. For the remaining element studied, lithium, Dr Aston gives a value  $6.928 \pm 0.008$ , in good agreement with some other recent physical determinations, but not in accord with the results of band spectrum analysis.

**Ammonium Phosphomolybdate**—Although the yellow precipitate formed from molybdic and orthophosphoric acids in presence of nitric acid is known to have the composition  $(\text{NH}_4)_3\text{PO}_4 \cdot 12\text{MoO}_3 \cdot 2\text{HNO}_3 \cdot \text{H}_2\text{O}$ , it is usually supposed to be formed only when ammonium molybdate is present in large excess, and hence that the method cannot be used for the determination of molybdenum. Special conditions in great number have been published in connexion with the use of the method in the determination of phosphoric acid. Kitajima, in the *Scientific Papers of the Institute of Physical and Chemical Research, Tokyo*, No 330 (October 1931), shows that molybdenum can, in fact, be determined by this method, and he has worked out the conditions for the determination of phosphoric acid.

**Chlorination of Benzene and Toluene**—It is generally known that in the chlorination of toluene at higher temperatures substitution occurs mainly in the side chain, whilst in the presence of halogen carriers in the cold the nucleus is substituted. Mason, Smale, Thompson, and T S Wheeler have described (*J Chem Soc*, Dec 1931) experiments on the chlorination of toluene and benzene in the vapour phase, the main object being to determine to what extent chlorine enters the nucleus of toluene at high temperatures in the absence of specific chlorine carriers, and to determine whether, as regards the kinetics of side-chain chlorination, this hydrocarbon can be regarded as a substituted methane, the chlorination of the latter

hydrocarbon having been investigated by Mason and Wheeler, whose results were published in the September issue of the same journal. The results show that in the absence of specific carriers chlorine enters the side chain, and also, with the same conditions of short periods of heating, the kinetic formulae developed by Martin and Fuchs in 1931 apply to toluene considered as a substituted methane. In the case of benzene, the main object was to investigate, with particular reference to the formation of monochlorobenzene, the extent to which substitution occurs at high temperatures, in the absence of specific chlorine carriers. It is shown that direct chlorination to chlorobenzenes takes place in the vapour phase above  $400^{\circ}$ , mono- and di-chlorobenzenes being the chief products. The rate of reaction is not so great as in the case of toluene. The results, in the case mentioned, are in good agreement with the kinetic formula for a two-stage reaction. The rate of reaction is increased by addition of iodine, a chlorine carrier, and other liquid-phase catalysts. With ferric chloride the proportion of dichlorobenzene formed is increased and a little trichlorobenzene is also formed.

**Bushings for Outdoor Transformers**—The increasing use of outdoor substations for the transmission of electrical power has made it necessary to adapt transformers for use in unprotected positions out-of-doors. The transformers are usually connected to overhead transmission lines, the junction between transformer

winding and overhead line being at the terminals, where the winding is brought out from the oil tank surrounding the transformer. These terminals are called outdoor bushings, and on their design a great amount of scientific and mathematical research has been expended. In a paper read to the Institution of Electrical Engineers on Dec 3, Mr W J John gave a careful résumé of the work that has been done previously and deduced some useful conclusions. The main requirements of a bushing are that it must withstand all the electric stresses due to its connexion with the overhead system, insulate the conductors when rain is falling on the transformer, and be absolutely water-tight so that moisture cannot get into the insulating oil. Before the engineer accepts bushings, they have to pass certain standard tests, but the severity of these tests should not be unduly high. They have to be tested under artificial rain conditions, the water used having a standard resistivity usually of 10,000 ohms per cm cube. The shape of the bushings is of importance, so that the electric stresses which govern flash-over and puncture may be computed. It is of special importance to prevent the brush discharges, usually called the corona. Mr John gave laws for corona and puncture-voltage, and also for the permissible voltage gradients. He showed that for any given flash-over distance under wet conditions, the corresponding dry flash-over distance can be fixed within narrow limits, experiment shows that the law connecting the two is linear.

### Astronomical Topics.

**Astronomical Phenomena for February**—Venus is becoming increasingly conspicuous as an evening star, the planet is drawing away from the sun, and going farther to the north of it, its stellar magnitude is  $-3.5$ , three-quarters of the disc being illuminated. Venus will be near the moon on the evening of Feb 9, and about a degree north-west of Uranus on the evening of Feb 26.

Jupiter is in opposition on Feb 7, satellite II will be in transit from 1.15 to 4.7 A.M. on this day, and will partially cover its own shadow, reference should be made to the British Astronomical Association Handbook for mutual eclipses and occultations of the satellites, the seasons for these only occur once in six years, so opportunities should not be missed.

Neptune is in opposition on Feb 26, it is then  $1\frac{1}{2}^{\circ}$  east of the fourth magnitude star  $\rho$  Leonis which will make the planet easy to pick up in small telescopes.

Occultations of stars by the moon occur at 9.11 P.M. on Feb 11, at 7.35 P.M. on Feb 16, and at 6.19 P.M. on Feb 18, the stars are rather faint. February is a good month to look for the zodiacal light, since the ecliptic then makes its greatest slope to the horizon in the evening sky. This applies only to those who are far from the glare of artificial lights. The most convenient minima of Algol occur at 11 P.M. on Feb 16 and at 8 P.M. on Feb 19.

The well-known variable star Mira Ceti is due to reach its maximum early in April, but it will then be too near the sun for observation. It should, however, be visible to the naked eye after the middle of February, and it is of interest to follow the increase of its light, which is fairly rapid. Its position relatively to  $\alpha$  and  $\gamma$  Ceti and to  $\alpha$  Piscium should be learnt from a map. A binocular is a help.

**A New Faint Comet, 1931 e**—This comet was found by Herr K. Reimmuth on Dec 31 in the course of the regular work on minor planets that is carried on at Königstuhl, Heidelberg. It was of magnitude 15, its motion did not differ greatly from that of a minor planet, but both he and Dr M. Wolf decided that it was a comet after inspecting its images on four dif-

ferent plates, its aspect was decidedly nebulous, its diameter being estimated as  $36''$ . The following positions are from *Rechen-Institut's* Circulars 530 and 533, they are referred to the equinox of 1925.

|        |                                     |     |                                  |      |         |
|--------|-------------------------------------|-----|----------------------------------|------|---------|
| Dec 31 | 19 <sup>h</sup> 29 <sup>m</sup> U T | R A | 3 <sup>h</sup> 49 <sup>m</sup> N | Decl | 37° 26' |
| Jan 10 | 18 58.4                             |     | 3 45.1                           |      | 37 22   |
|        | 12 21 41.0                          |     | 3 44.7                           |      | 37 21   |

No orbit is yet to hand, but the above figures suggest that the comet was stationary in R.A. about Jan 16, in which case it would be near the discovery position at the end of January.

The comet was within a few degrees of 1931 d (Neujmin 1), but identity is not possible, the orbit of Neujmin being well known, moreover, it had sunk to magnitude 17 in December, and showed no sign of nebulousity at this apparition.

**Nova Pictoris**—A series of observations has been published (*Mon Not Roy Ast Soc*, Nov) of the components of this star made with the 26 $\frac{1}{2}$ -inch refractor at the Union Observatory, Johannesburg, by W H van den Bos and W S Finsen, they also include some made at Lembang, Java, by Dr J Voute. An interesting point is the outward movement of the components B, C from the principal star A. The measured distances early in 1928, 1929, 1930, and 1931 were for B  $0.35''$ ,  $0.55''$ ,  $0.84''$  and  $0.95''$ , for C they were  $0.38''$ ,  $0.60''$ ,  $0.80''$ , and  $0.98''$ . The faint component D remained nearly constant at  $0.27''$ , it was not visible in 1931. The nebulous and unsymmetrical character of the central nucleus A added to the difficulty of the measures, B and C faded more rapidly than A, in 1929 they were fainter than A by 1.6 and 2.1 mag, in 1931 by 2.6 and 3.6 mag. The paper compares Nova Pictoris with Eta Argus, it is recalled that Dr Innes detected two near companions of Eta Argus in 1914 and 1915, also the disc of the principal star appears nebulous in the 26 $\frac{1}{2}$ -inch. The light-curve of Eta Argus resembles that of a nova, differing only in the slowness of the changes, Nova Pictoris has also been slower than the average nova, but much more rapid than Eta Argus.

### The Kinematograph in Education.\*

AN account of what has been called "The Middlesex Experiment", carried out with sound films by a joint committee on which various educational authorities in the county were represented, has recently been published. The experiment was made possible by the generous offer of the Western Electric Company to provide, free of charge, sound film equipment and the services of competent operators. Sixteen films were used, divided into four groups, six had geographical value, four dealt with biology or nature study, and the other six were of general interest. These were lent by British Instructional Films and British Movietone News.

The value of the films to the children (3600, in fifteen schools) was tested in the first instance by questions set on each film, easier questions in some cases for the junior pupils and more difficult questions for the senior pupils, with an essay in special cases. A questionnaire on the value of each film was answered by a teacher in each school. Final conclusions were drawn from an examination of these sources of information, control classes taught in the usual way without films being considered too cumbersome.

It may be said at once that, if the opinions of teachers are worth anything, a case is made out for the use of films in educational work in schools. There is, indeed, plenty of criticism, one of the facts that emerged is that even the best film material available for use in schools is unsatisfactory in numerous respects. But it is also stated that "even the least satisfactory among the films used in the experiment had a certain value as instruments of education, the better films were frequently stated to be of very considerable value". The films created a liveliness of mind and desire for further learning that is not taken account of in any assessment of answers to questions on the scenes exhibited.

It is curious, however, that while the title of the volume is "Sound Films in Schools", and while, in fact, sound films were used, the emphasis seems to be laid not so much on the sound film as compared with the silent film or with the ordinary lesson, but on results of using the sound film with pupils of different grades of intelligence. We are not impressed by the evidence that the sound film is "superior" to the silent film. There is, indeed, the statement that "the

\* Sound Films in Schools: the Report of an Experiment undertaken jointly by certain Local Education Authorities and by the National Union of Teachers in the Schools of Middlesex. Pp viii+120+8 plates. (London: The Schoolmaster Publishing Co., n.d.) Cloth, 2s 6d, paper, 1s 6d.

general consensus of opinion on the part of teachers consulted is that they [the sound films] are preferable to silent films for educational purposes", but the statement comes as a shock to the reader. Practically no evidence, statistical or other, is adduced to support the statement in this extreme form. So far as can be gathered, there were no control experiments with adequately captioned films, and it is certainly interesting to note that one of the most common criticisms of the films was that there were too few captions.

On the other hand, there are many solid results of the investigation and suggestions for further inquiry. The children were divided into those of average ability and those described as backward, and probably the most striking result of the experiment was the value of the film to the backward pupils, it is, indeed, in the case of the backward pupils that the value of the sound film is most clearly demonstrated. Another very striking result, though it is rather belittled in the text, is that the lesson should follow the film—not precede it. The evidence for this (as given in Table XVIII) is overwhelming. The result is as important as it is striking. It implies that, under the conditions of the experiment, the picture was *not* an illustration but the raw material.

The experiment, in fact, marks another advance in our knowledge of how to use films in school. The criticisms of teachers have led to the formulation of definite requirements that such films must fulfil. The committee of the Geographical Association, which has been investigating silent films, has come to almost identical conclusions. It may, therefore, be taken for granted that all school teaching films, sound or silent, must have the following qualifications:

- (1) The film must be coherently planned
- (2) It should be short and aim at conveying one main idea
- (3) All essentials to the main theme must be included and irrelevances ruthlessly excluded
- (4) The commentary should be in simple language and should anticipate the picture
- (5) Talking down and cheaply humorous touches must be avoided
- (6) The repetition of essential action is recommended
- (7) Films should be correlated with recognised courses of study
- (8) Only such subjects should be shown in film form as cannot be more effectively dealt with through another medium

### Pit-Dwellings in Arizona.

FOR several seasons past Dr Frank H. H. Roberts, Jr., has been engaged on behalf of the Bureau of American Ethnology, Smithsonian Institution, Washington, D.C., in the investigation of archaeological sites in Arizona and Colorado, with the view of tracing the development of the culture of the 'Basketmakers', the prehistoric inhabitants of the arid areas of the south-western United States, and its relation to that of the early Pueblo Indians. The following is a report of the field-work in the summer of 1931, which has revealed what would appear to be a hitherto unsuspected phase in the development of the multi-cellular dwelling characteristic of later Pueblo culture.

During the summer field season of 1931 investigations were carried out at a site three and a half miles south of Allantown, Arizona. When the work

was brought to a close at the end of September the subterranean portions of fourteen pit-houses had been cleared of the debris which accumulated in them during the centuries which have passed since their abandonment. Several of the dwellings had been destroyed by fire, and the charred remnants of timbers lying on the floors demonstrated clearly the methods of roof construction. This evidence, together with the nature of the pits which remain, makes possible the drawing of an accurate picture of the type of dwelling in vogue during the early stages in the occupation of the site.

The semi-subterranean houses were rather crude. They had consisted of a circular, oval, or rectangular excavation roofed over with a pole, brush, bark, and plaster superstructure. The earth walls of the pits were covered with plaster made from adobe mud in



which there was a small admixture of ashes. The pits ranged from 0.91440 m to 1.524 m in depth and from 3.048 m to 6.096 m in diameter. The superstructure erected over the pits was supported by four upright posts set in the floor a short distance from the walls. The upper ends of these main supports were forked, tree trunks with suitable crotches having been obtained for the purpose, and carried crossbeams. These stringers formed a rectangular framework against which were placed the upper ends of smaller timbers, the butts of which rested on the ground some distance back from the edges of the pit. The slanting poles formed the main part of the sloping upper walls of the house. At the top the rectangular space was covered with a flat roof, with an opening near the centre which functioned as a smoke-hole and entrance. The entire framework was covered with brush, leaves, and strips of cedar bark. On top of this a thick layer of mud plaster was spread, and over all there was a thin coating of earth. Indications were that the tops of the roofs were only elevated above the ground sufficiently to provide for drainage. A village composed of houses of this type would not be striking in appearance, since all that an onlooker would see would be a series of low, rounded mounds with the ends of ladders projecting through rectangular openings in their tops.

The interior features of such houses were simple. Near the centre of each, directly under the opening in the roof, was a fire pit. Close to it, on the south-east side, was a second depression in the floor, in which rested the lower end of the ladder used in gaining access to the chamber. An occasional dwelling had a storage recess in the wall. Where these were present they were on the floor level, none was placed above it. At the east or south-east side of each room there was an aperture in the wall, which opened into a short tunnel. The latter led to a vertical shaft the outlet of which was on the ground-level some distance from the edge of the roof mound. This constituted the ventilator. The nature of the houses was such that a constant supply of fresh, cold air was drawn down into them through this ventilator. Between the opening in the wall and the fire pit, at the base of the ladder, an upright slab of stone was set in the floor. This is called the deflector, and was so placed to pre-

vent the rushing air from blowing directly on the fire. The draft at times was so strong that it was necessary to stop completely the opening. A well-worked oval slab of stone was provided for this purpose. The cover stones were found in position over the opening in a number of the pits when they were excavated.

Houses of the type just described generally stood alone, but in two different groups at this site they were connected. There were no partitions at the sides where they joined, and long, narrow dwellings resulted. One of the examples was composed of two and the other had three connecting chambers. Each room was complete in itself, to the minutest detail, but because of the lack of a separating wall, became an integral part of the larger structure. It is possible that the two groups represent one of the prototypes for the communal dwellings which in later times were erected above ground. If such were the case, there is in this distinct evidence of an interesting variation in the evolution of the house. In the more northern parts of the south-west archaeological area, the single family domiciles had practically emerged from the ground before the development of the multiple-roomed structures began. In general it may be said that the structures uncovered in 1931 conformed to the widespread semi-subterranean type of house built in many sections of the south-west. They are particularly comparable to the pit-dwellings which Dr. Roberts found during previous investigations in the Chaco Canyon, in north-western New Mexico, and at the old Long H Ranch, Arizona, about 48.280 km south and west of the Allantown location. All showed individual differences and variations, but in their main essentials they exhibited a striking similarity.

The Allantown site is of considerable importance, because trenching has shown that it contains four distinct and sequent levels of occupation. Complete excavation will throw light on the closing days of the Basketmakers, show the beginnings of the Pueblo culture, and trace its growth through two subsequent periods. The houses excavated in 1931 belong to the Pueblo I phase. Investigations will be resumed in the present year, when further portions of the site will be cleared.

### Fuel Research in Great Britain.\*

THE Report of the Director of Fuel Research for the year ending March 31, 1931, has only recently been issued. The delay in publication, usual with official documents, detracts somewhat from the freshness of its contents, for in recent months, at the centenary meeting of the British Association and other gatherings, the status of fuel processes has been the subject of repeated discussion.

There is a discussion by the Director of the economic status and prospects of the evergreen topic of low-temperature carbonisation of coal. He expresses the opinion that the receipt from the coke will have at least to cover the cost of the coal carbonised. The coke must fetch more per ton than the coal from which it is made. The crux of the question is the price which the nation is prepared to pay for the reduction of smoke nuisance, while at the same time retaining the open domestic fire. The damage and expense incurred by burning a ton of raw coal in the domestic hearth has been calculated to be 10s., and if this sum could be included in the balance-sheet there is little doubt that the production of free-burning

cokes would soon become a flourishing industry. It must be remembered that gas and ordinary gas-works coke are both smokeless fuels, the uses of which are extending, as is the use of electricity for many domestic purposes. Indeed, the rapidly growing use of gas coke as a fuel for open grates of suitable design is a factor which should not be overlooked.

The Report states that the benefit to the mining industry would be less than frequently claimed, because the use of carbonised fuel would merely displace house coal, the demand for which would be correspondingly reduced. The fall in the value of liquid fuels which has occurred in recent times places a great obstacle in the way of new carbonisation industries, and also of the production of oils by the direct hydrogenation of coal.

Low-temperature tars regarded as fuel oils or 'cracking stock' have defects. On the other hand, they appear to lend themselves to conversion into stable oils and motor spirits by hydrogenation. The Report gives the results of encouraging experiments in this direction, and it seems that the hydrogenation of tar may advance more rapidly than the direct hydrogenation of coal.

The Report reviews the circumstances in which the

\* Department of Scientific and Industrial Research. Report of the Fuel Research Board for the year ended 31st March 1931 with Report of the Director of Fuel Research. Pp viii + 104 + 2 plates. (London: H.M. Stationery Office, 1931.) 2s. net.

Gas Light and Coke Company came to select the low-temperature carbonisation system developed at the Fuel Research Station for a full scale commercial trial at the Richmond Gas Works. Various causes led to the cessation of the experiments before, in the opinion of the Department and the Mines Department, a conclusive result was obtained. One of the principal difficulties encountered was the distortion of the metal retorts employed. This distortion resulted in an unduly heavy charge for replacements being added to the cost of the working of the plant. In view of the very promising results and increased throughput recently obtained at the Fuel Research Station with a brick retort, it is proposed to erect and work as steadily as possible two new retorts of that type at the station, so as to obtain further data regarding the life and working of such retorts. The disappointing results of this attempt to develop an apparently promising low-temperature process illustrate the need for caution in forecasting the commercial prospects of new schemes in this field.

Very interesting results have been obtained with horizontal gas retorts. By modifying the method of heating the retorts, the daily throughput has been increased by 70 per cent. The effect of this on the economics of carbonisation may be far-reaching, for more than seven million tons of coal are carbonised daily in such plant.

The organisation of the Physical and Chemical Survey of the National Coal Resources has now been almost completed, and covers practically all the coal areas in the country.

Many other aspects of the national fuel problems are touched in this interesting report.

### Treatment of Fodder Crops.

VARIOUS are the proposals for restoring arable farming to its former prosperous state. Apart from the recent Government promise of establishing a quota for wheat, we have had such interesting suggestions as Prof. Orwin's mechanised farming, which is already being tried in various parts of the country, and the erection of canning factories in which fruit and vegetables take the place of wheat, and of which two are already being built in Norfolk alone. Yet a third proposal which seems worthy of trial is the so-called 'Mason System for Harvesting and Drying Green Fodder Crops'. The process invented by Mr. Arthur J. Mason is the result of twenty years' experimental work, and has been in commercial operation in the United States since 1926. It aims at producing home-grown feeding stuffs by artificially drying green fodder crops cut before the flowering stage and converting them directly into high-grade feeding-stuffs of comparable value with such imported products as cake, cereals, wheat offals, etc., at a distinctly lower price. The Rothamsted Experimental Station is already running some eighty experimental plots with the view of discovering the most suitable crops in Great Britain for the Mason process.

Investigations seem to show that crops thus grown in place of cereals will increase the yield of English arable lands about three and a half times (in food and monetary value) and assure the farmer a net profit of £2-£5 an acre, provided that the crop is cut three or four times in the season—a perfectly feasible matter if the crop is cut before flowering sets in. In such cases the normal yield per acre is, compared in feeding value with cereals, 3 to 4 tons per acre against 0.8 tons of wheat, the value of the product being  $3\frac{1}{2}$  times as high. The system has the further advantage of completely eliminating the more or less

considerable loss in hay-making caused at present by the ordinary vagaries of the English climate. The crop, in fact, can be cut at any time, regardless of the weather, and the feeding value of the product is approximately double that of the ordinary sun-dried hay, there being no loss of proteins or vitamins by 'wilting' in the sun or by exposure to wet. This, with lucerne, which yields in the case of ordinary hay-making about 12 per cent protein, the content of protein rises to 18 or 20 per cent when treated by the Mason process.

The installation costs approximately £7600, allowing £3500 for the drying plant and the rest for harvesting and haulage. It is capable of dealing with the product of 800 to 1000 acres, and should produce about 2600 tons of concentrates, worth £15,600 to £20,000, per annum, which could be grown within a three-mile radius in any arable district. Each factory could be organised as a single operating company, which purchases the standing crops and carries out the harvesting and the drying, the farmer receiving £2 per ton (dry) for his crops. Obviously in view of the farmers' sad experience with the sugar beet factories, the farmers concerned should have a direct interest in the factory and some say in the prices. The factories would first concentrate on the production of fine ground meal for poultry food, for which there is an immediate market, but the product has also been found invaluable for cattle and sheep feeding. Considering the costliness of erecting sugar-beet factories and the large amount of the sugar-beet subsidy, it would be quite worth while for the Ministry of Agriculture to consider if some of the subsidy might not be diverted to encouraging the erection of some of these factories, of which the cost appears extremely modest. The system was recently brought to the notice of Section M (Agriculture) of the British Association by Sir Richard Paget, Bt. (1 Devonshire Terrace, London W.2), from whom further information can be obtained.

### University and Educational Intelligence.

CAMBRIDGE—A. S. Paterson has been appointed to the Pinsent-Darwin studentship for three years from Oct. 1.

The council of the Senate has issued a report on accommodation for the Department of Mineralogy and Petrology. It is recommended that a new building covering about 5600 sq. ft. and containing four floors should be constructed between the Sedgwick Museum and the Department of Physiology.

At Emmanuel College, Mr. F. T. Brooks, University reader in mycology, has been elected to a reserve official fellowship.

LONDON—At a meeting of convocation on Jan. 1 the Earl of Athlone was elected chancellor of the University. The installation ceremony will be held at the University on Feb. 18.

The following degrees have recently been conferred: D.Sc. (Statistics and Eugenics) on Ethe Mary Elderton (University College) for "Report on the English Birthrate" (*Eug. Lab. Publications*, 1914) and "On the Factors which influence Infant Welfare" (*Annals of Eug.*, 1926-29); D.Sc. (Economics) on Hilda Rodwell Ormsby (London School of Economics) for "The Geography of France—Regional and Economic" (Methuen, 1931).

The following titles have been conferred in respect of posts held at the Colleges indicated: Professor Dr. Robert Robinson (biochemistry, Lister Institute of Preventive Medicine); Reader Dr. J. M.

Gulland (biochemistry, Lister Institute of Preventive Medicine), Dr William Robson (biochemistry, King's College), Dr Edward Mallett (electrical engineering, Imperial College—City and Guilds College), Mr Albert Rushton (electrical engineering, Imperial College—City and Guilds College), Dr G I Finch (general chemical technology, Imperial College—Royal College of Science), Mr V C Illing (geology—petroleum technology, Imperial College—Royal School of Mines), Dr A Morley Davies (palaeontology, Imperial College—Royal College of Science)

NOTTINGHAM—The Massey scientific research fellowship, of the value of £400 per annum, which has recently been established at University College, Nottingham, for the purpose of promoting research on cancer by physical and chemical methods, has been awarded to Dr L A Woodward. After two years' research under Dr N V Sidgwick at Oxford, Dr Woodward was awarded a senior grant by the Department of Scientific and Industrial Research to carry on, under Prof P Debye, spectrophotometric research on the Raman effect in electrolytes

APPLICATIONS are invited for Tate, Morgan, and Holl scholarships at the Battersea Polytechnic. The scholarships range in value from £20 to £30 per annum with free tuition and are tenable for two or three years. Particulars are to be had from the Principal, Battersea Polytechnic, SW 11. The last day of entry is April 16.

At a dinner, on Jan. 18, given by the Argentine Chamber of Commerce in Great Britain, the Prince of Wales announced the provision of scholarships at the University of Oxford, on the lines of the Rhodes scholarships, to enable students from the University of Buenos Aires to study in Great Britain. So far, provision has been made for two students from the University of Buenos Aires to go to the University of Oxford for a period of two years.

THE subject for the essay for the Cecil Peace Prize of £100, which is offered annually for an essay on some topic connected with the maintenance of international peace, has been announced. For the year 1932, the subject is "The Danger from the Air. Discuss possible methods, by International Convention or otherwise, of dealing with it." Further particulars can be obtained on application to the Secretary, Universities Bureau of the British Empire, 38A Gower Street, London, WC 1.

### Calendar of Geographical Exploration.

Feb. 3, 1488—The Cape of Good Hope

Bartholomew Diaz de Novaes touched the south coast of Cape Colony at Mossel Bay (Bahia dos Aqueros), midway between the Cape of Good Hope and Port Elizabeth. Diaz sailed from Lisbon for the Congo river in 1487 and thence surveyed the coast of Africa southwards to Walfish Bay. The currents off the South African coast hampered him, and he sailed far to the south of the Cape of Good Hope into the region of the westerlies, but finally reached the coast on the above date. Thence he proceeded to the mouth of the Great Fish river, but the discontent of the officers and men compelled him to return. In December 1488 he was back in Lisbon. His voyage opened the way for the route round Africa to the east, and added 1260 miles of coast-line to the map of Africa. Fragments of the pillar which he erected on Diaz

Point in 26° 38' S. (South-West Africa) still remain. Diaz accompanied Cabral on his voyage in 1500, when Brazil was discovered, and should have helped to guide the fleet thence to India, but perished in a great storm off the Cape of Good Hope.

Feb. 3, 1643—Japan and Sakhalin

Martin Gerritszoon Vries sailed with two ships from Batavia in search of imaginary islands, one supposed to be rich in gold and one in silver. The ships were nearly wrecked off Nippon, but reached Yezo and discovered an island, probably Iturup, passing through the strait which still bears the name of Vries. Part of the coast of Sakhalin was then explored, and descriptions of the hairy Ainu were brought back. The companion ship, instead of sailing through Vries Strait, passed along the outer shores of the Kurile Islands, reaching 47° 8' N, twelve degrees east from the most easterly point of Nippon.

Feb. 4, 1823—Lake Chad.

Lake Chad was seen by Europeans for the first time. Denham, Clapperton, and Oudney had set out from Tripoli in the hope of gaining further knowledge of the Niger. The party crossed the Sahara, reached Bornu, explored Lake Chad, and proved that the Niger was in no way connected with it. They brought back accounts of the Arabs, the Berbers, the Fulah, and of many negro tribes. The information thus collected about the kingdoms of the Central Sudan threw much light on the writings of Arab travellers.

Feb. 5, 1725.—Bering's Voyages.

Vitus Jonassen Bering set out from St Petersburg to conduct an expedition to north-east Siberia in order to find whether Asia and America were separate. Peter the Great had appointed Bering to be commander, but in 1724 Peter died before the preparations were completed. Bering and his companions crossed Siberia by land, going from stream to stream and carrying with them the materials for the boats, which were built in Kamchatka. Bering sailed north-eastwards along the coast of Kamchatka, surveying it as he went. On Aug. 15, 1728, he sailed past the north-eastern promontory of Asia in 67° 18' and observed that the coast trends westwards, as the Chukchee had already told him. He considered that he had thus fulfilled his mission and returned to Kamchatka, whence he tried to reach America, but was driven back by bad weather conditions.

In 1740, Bering fitted out two vessels at Okhotsk, the *St. Paul* and *St. Peter*, the latter being commanded by Chirikov, and they set out for America. During a storm the vessels separated. Bering reached America between lat. 58° and 59° N, where the naturalist, Steller, who was with him, noted the volcano, Mount St. Elias. With great difficulty owing to continuous fog, the *St. Paul* rounded the peninsula of Alaska. Scurvy broke out among the crew, and the ship drifted helplessly at the mercy of wind and wave among the Aleutian Islands. It finally ran aground on Bering Island, where Bering died on Dec. 8. Thirty-two out of a party of seventy-six had died, but the survivors built a new vessel, and ultimately reached Kamchatka. Steller wrote a full account of the six months' stay on an uninhabited island, giving a valuable description of the fauna. Chirikov also reached the coast of America, in lat. 56° N. Bering's voyages decided the question of the existence of a strait between North Asia and North America. The strait had been passed by Dezhnev eighty years before, but no record had been kept of this. Bering's and Chirikov's voyages brought to light the existence of the long chain of volcanic islands between Alaska and Kamchatka.

## Societies and Academies.

## LONDON.

Royal Society, Jan 21 — C Donhoff and J J. R. Macleod Studies in the nervous control of carbohydrate metabolism When decerebration is performed through the pons in rabbits under amytal anaesthesia, the percentage of blood sugar rises very high after the effects of the anaesthetic have passed off After pontine decerebration the percentage of lactic acid increases in the blood and the percentage of glycogen decreases in the muscles, but may either increase or decrease in the liver No relationship exists between the degree of decerebration, hyperglycaemia, and the percentage of glycogen initially present in liver and muscles, and when previously fasted animals are used it is impossible to account for the hyperglycaemia by the sugar arising from the glycogen which disappears. It is concluded that a process of gluconogenesis is responsible for most of the extra sugar, but it has so far proved impossible to determine the extent to which protein and fat contribute towards its production. In fasted animals, having small percentages of glycogen in the liver and muscles, pontine decerebration fails to induce hyperglycaemia after double adrenalectomy, or administration of atropine, ergotamine, or amytal It is concluded that decerebration hyperglycaemia is in large part due to stimulation through the autonomic nerves of some process by which the liver discharges sugar in excess of that available from the glycogen initially present in it Since amytal paralyses this pathway, it prevents the rise in blood sugar percentage following pontine decerebration, piqûre, and asphyxia, but not that due to the injection of large doses of adrenaline — W T Astbury, T C Marwick, and J D Bernal X-ray analysis of the structure of the wall of *Valonia ventricosa* (1) The cell-wall is built up of two main sets of cellulose chains which form crystallites crossing at an angle maintained remarkably constant through the whole thickness and over considerable areas of the wall The orientations of the cellulose chains are parallel to the directions of the fine crossed striations which may be detected on the surface of the wall The extinction directions shown by the wall in polarised light lie between the directions of the cellulose chains and vary in a manner determined by the inter-chain angle and the relative proportions of the chains associated with each orientation — F A Askew, R B Bourdillon, H M Bruce, R K Callow, J St L Philpot, and T A Webster Crystalline vitamin D Further purification of the antirachitic principle has been achieved by esterification of the crystalline distillation products formerly described as calciferol The purified calciferol now obtained has an antirachitic activity twice as great as any previously recorded, and appears to be identical with the vitamin D<sub>2</sub> of Linsert and Windaus A simplified process is described for preparing the pure product from the irradiation products of ergosterol without distillation An account is given of two inactive compounds termed pyrocalciferol and sterol X Evidence is given of the relations between the crystalline antirachitic products hitherto described, showing that the activity of each of them is due to one common constituent Thus the vitamin D<sub>1</sub> of Windaus is a compound of calciferol (=vitamin D<sub>2</sub>) and sterol X, and the crystalline distillation products first described contained pyrocalciferol and sterol X, as well as calciferol (See also NATURE of Oct 31, 1931, p 758, and Jan 9, p 50)

## PARIS

Academy of Sciences, Dec 21 — A. Lacroix The members and correspondents of the Académie royale des Sciences (1666–1793) — Paul Pascal and Pierre Minne The existence and preparation of lead suboxide The only method of preparation giving a definite compound is the decomposition of lead oxalate at 275°C in a vacuum (1 mm) The magnetic susceptibility proves that it does not consist of the mixture Pb+PbO The pure suboxide (Pb<sub>2</sub>O) cannot be obtained by the reduction of lead monoxide — Lucien Lichtenbaum A topological invariant — E Pinte Congruences of straight lines and parallel surfaces in Hilbertian space — Jacques Networks the tangents of which belong to linear complexes and non-Euclidian surfaces of constant total curvature — Paul Mentré The projective application of a quadratic complex on the non-special linear complex — F Marty The iteration of certain algebraic functions — M Davin The elastic state of an indefinite two-dimensional body pierced by a circular hole — D Belorizky The application of Sundman's methods to the problems of celestial mechanics — A Lallemand The preparation of two types of aqueous solutions of cobaltous salts Study of their magnetic state as a function of the dilution Two types of solutions of cobalt salts are known, in the first the magnetic susceptibility is constant and independent of the concentration, in the second the magnetic susceptibility increases with dilution to a sharp maximum The author gives the conditions for preparing either of these types of solution at will — L Neel The magnetic properties of iron above the Curie point From studies of the magnetic properties of iron-tin alloys and iron-silicon alloys at temperatures ranging from 800°C to 1100°C, the ferromagnetic Curie point found ( $\theta_f$ ) is 772°C, and the paramagnetic Curie point ( $\theta_p$ ) is 815°C — Mile. A Serres The magnetic moment of tetravalent cobalt From a study of magnesium cobaltite (MgO CoO<sub>2</sub>), the magnetic moment of Co<sup>+++</sup> is found to be 29.0 magnetons — E Rinck An allotropic transformation of barium in the solid state Barium, fractionally redistilled in a vacuum, is attacked by carbon dioxide and can only be handled in argon Its melting point was redetermined and found to be 710°C From a study of the electrical resistance two allotropic forms of barium are shown to exist  $\alpha$ -barium stable below 375°C. and  $\beta$ -barium stable between 375° and 710° C — Mion Contribution to the study of the system water, ethyl alcohol, acetic acid, ethyl acetate The miscibilities of the ternary system (water, alcohol, ethyl acetate) and quaternary system have been determined at 0°, 15°, and 30° C the results are given in tabular form — M Bourgue and L Piaux The Raman effect and chemistry the allene linkages The Raman effect for allene and its derivatives shows that these hydrocarbons contain neither an ethylene nor acetylene linkage Hence the usually accepted formulae require revision — Jean Cournot The influence of the state of the surface on the corrosion of rustless steels The effect of the condition of the surface on corrosion is specially marked in the case of rustless steels to obtain maximum resistance to corrosion it is necessary to polish the surface with the finest grade emery — Mile Suzanne Veil Precipitations stratified in spirals — M Patry and P Lafitte The beginning of the explosive wave in mercury fulminate — Frank A Perret The new dome of Mt Pelée — Emile F Terroine and H Trimbach The urinary excretion of ketonic substances during starvation in various species of animals Experiments on the pig, rabbit, dog, cat, and rat showed no increase in ketonic sub

stances excreted in the urine during starvation, on the contrary, there was a reduction. The increase observed in man and in the primates appears to be exceptional.—J Errera. The electrometric titration of the proteins. The isoelectric points of the albumins and globulins are in the acid region ( $pH$  4–5.5), whilst those of the prolamines and glutelins are in the alkaline region ( $pH$  8–10).—Paul Fleury. The glycerophosphomolybdates. In the glycerophosphates the phosphoric acid still possesses, although in a weakened form, the property of forming complex compounds with molybdic acid. Two of these have been isolated in the crystalline condition, sodium  $\beta$ -glycerophosphomolybdate and potassium  $\beta$ -glycerophosphomolybdate.—A Ch Hollande and Mme G. Hollande. The cytology of *B. coli*.

## SYDNEY.

Royal Society of New South Wales, Nov. 4.—A R Penfold. The essential oil of *Leptospermum Liver- sidgii* var B and the occurrence of isopulegol. The presence of *d*- $\alpha$ -pinene, citronellal (33.42 per cent), and sesquiterpene alcohol was confirmed, and the occurrence of isopulegol both free and combined as caprylic acid ester revealed. The isolation and identification of this alcohol is the first authentic record of its occurrence in Nature.—E. Cheel. Notes on the *Pericalymna* section of the genus *Leptospermum*, with descriptions of three new species. An account was given of the first collection of plants commonly known as 'tea-tree' in Australia or 'manuka' in New Zealand, made by John Reinhold Forster and his son, George Forster, who accompanied Capt Furneaux of the *Adventure*, which left England in 1772, on Capt Cook's second voyage to the shores of Australia. Three new species were described. *L. trivalvum* has small capsules, normally three-valved. The plant otherwise resembles *L. myrsinoides*, which is confined to Victoria, whereas the new species is widespread over the western and southern parts of New South Wales, extending to Victoria. *L. sphaeocarpum* has spherical-shaped fruits, and has affinities with *L. nudum*, a Tasmanian species. *L. semibaccatum* has fruits somewhat berry-like when fresh, an unusual character for this group of tea-trees.

## VIENNA.

Academy of Sciences, Oct 15.—A Kailan and J Kohberger. The velocity of catalysed hydration.—L Moser and H Hackhofer. The determination and separation of rare metals from other metals. (20) The determination of iridium and its separation from platinum and other metals. Hydrolysis was used and also bromide-bromate.—L Moser and H Graber. The determination and separation of rare metals from other metals. (21) The determination of rhodium and its separation from platinum and other metals. Oxidising hydrolysis was in many cases successful.—W J Muller, H K Cameron, and W Machu. The theory of passivity phenomena. (14) The passivity of nickel. The substances forming surface layers are the natural nickel oxide which forms in air, basic nickel sulphate, double refracting nickel sulphate pentahydrate, nickel peroxide.—J Kuhntrieber. New Plecoptera larvæ.—F J Widder. *Draba norica*, a new plant of the Eastern Alps.—A Rollett and F Scholz. The course of esterification with mixed anhydrides and mixtures of anhydrides.—M Mladenovic. The elemic acid from *Manila elemi* resin. (3) The elemic acid, its hydration product, and bromo-hydro-elemic acid.—A Dadiou, K W F. Kohlrausch, and A Pongratz. Studies on the Raman effect. (16) The Raman spectrum of organic substances (cis-trans-isomerism).—A Dadiou and F A Schneider. Raman effect and constitution of nickel carbonyl.—S Pelz. Electrolytic coloration of alkali halide crystals.

## Forthcoming Events.

## Societies.

## FRIDAY, JANUARY 29

SOCIETY OF MEDICAL OFFICERS OF HEALTH (Fever Hospital Medical Service Group) (at 1 Upper Montague Street, W C 1), at 4.—Dr E W Goodall, Pre-bacterial Views of Infectious Diseases (Presidential Address). ROYAL ASTRONOMICAL SOCIETY (Geophysical Meeting), at 5.—Prof E V Appleton. Upper Air Ionisation. ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith. Malformations of the Human Body considered from a New Point of View (Hunterian Lecture).

## MONDAY, FEBRUARY 1

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof J P Hosford. Some Factors in the Causation of Hydronephrosis (Hunterian Lecture). ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting. SOCIETY OF ENGINEERS (at Geological Society) (Inaugural Meeting for Year), at 6.—F W Mackenzie Skues. Presidential Address. INSTITUTE OF FUEL (at Institution of Electrical Engineers), at 6.30.—Presentation of the Melchett Medal to Prof. Bone and delivery of the Melchett Lecture by Prof Bone. A Century of Fuel Economy. ROYAL SOCIETY OF ARTS, at 8.—Capt O A Barrand and G A Green. Life-Saving Appliances on Merchant Ships (Thomas Gray Lectures) (3).

## TUESDAY, FEBRUARY 2

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof C A Edwards. The Progress of Research relating to Physical Metallurgy (3).

## WEDNESDAY, FEBRUARY 3

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof R T Payne. Excretion Urography (Intravenous Pyelography) (Hunterian Lecture). ROYAL SOCIETY OF ARTS, at 8.—A Broughton Edge. Geophysical Methods of Prospecting. ROYAL SOCIETY OF MEDICINE (Medicine and Surgery Sections), at 8.30.—Special Discussion on Diagnosis and Treatment of Abscess of the Lung.

## THURSDAY, FEBRUARY 4

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—M H A Newman. Topological Methods in the Theory of Continuous Groups (Lecture). ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof H G Cannon. Feeding and Digestion of Invertebrates (3).

## FRIDAY, FEBRUARY 5

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.—Discussion on Common Colds and their Sequelæ. ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A R Hobbs. Puerperal Sepsis, with an Account of the Treatment of Puerperal Infection by Glycerine Drainage (Hunterian Lecture). GEOLOGISTS' ASSOCIATION (in Botany Theatre, University College) (Annual General Meeting), at 7.30.—Prof W W Watts. Fossil Landscapes (Presidential Address), and presentation of Foulerton Awards to F Gossling and Dr S W Wooldridge. ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr G C Simpson. Weather Forecasting.

## Public Lectures

## FRIDAY, JANUARY 29

IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5.30.—Dr T M Finlay. The Evolution of Landscape. The Desert (Swiney Lectures) (11).

## SATURDAY, JANUARY 30

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr A I Richards. Women's Life and Work in a Central African Tribe.

## MONDAY, FEBRUARY 1

- LONDON SCHOOL OF ECONOMICS, at 5—H D Henderson Trade Theories and the Great Depression (1) (Succeeding Lectures on Feb 8, 15, and 22)
- GUY'S HOSPITAL MEDICAL SCHOOL (in Physiological Theatre), at 5—Prof H A Harris The Use of X-Rays in Physiological Investigations
- IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5 30—Dr T M Finlay The Evolution of Landscape The Ocean and its Work (Swiney Lectures) (12)
- KING'S COLLEGE, LONDON, at 5 30—Dr A M. Blackman Egyptian Myth and Ritual

## TUESDAY, FEBRUARY 2

- LONDON SCHOOL OF ECONOMICS, at 5—Dr A F Meyendorff Modern Theories of Law The Psychological Theory
- UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5 15—Dr E W Fish The Pathology of Dentine and the Dental Pulp

## WEDNESDAY, FEBRUARY 3

- ROYAL INSTITUTE OF PUBLIC HEALTH, at 4—Dr D M Connan The Social Burden of the Rheumatic Diseases
- SCHOOL OF ORIENTAL STUDIES (jointly with Royal Anthropological Institute), at 5—C W Hobley The Development of Native Education in Kenya
- BEDFORD COLLEGE FOR WOMEN (in Physiological Department), at 5 15—Prof S J Cowell Modern Aspects of Nutrition (Succeeding Lectures on Feb 10, 17, and 24)
- BELFAST MUSEUM AND ART GALLERY, at 8—J J Ward Wonderland of the Spiders

## THURSDAY, FEBRUARY 4

- SCIENCE MUSEUM, SOUTH KENSINGTON, at 4 30—Sir Henry Lyons Historic Meteorological Instruments
- KING'S COLLEGE, LONDON (at 40 Torrington Square, W C1), at 6—S P Turn Economic Conditions in Russia To-day The Shortage of Qualified Labour and the Seven Year Plan

## FRIDAY, FEBRUARY 5

- UNIVERSITY COLLEGE, at 5 30—H N Gresley High Pressure Locomotives—Prof H A R Gibb The Climax of Arab Culture

## SATURDAY, FEBRUARY 6

- HORNIMAN MUSEUM (Forest Hill), at 3 30—Prof J R Ainsworth-Davis Shell-Fish in relation to Man

## Official Publications Received.

## BRITISH

- Philosophical Transactions of the Royal Society of London Series A, Vol 230, A690 Photographic Investigation of Flame Movements in Gaseous Explosions, Parts 4, 5 and 6 By Prof William A Bone and Reginald P Fraser Pp 363 385+plates 13 20 (London Harrison and Sons, Ltd)
- University of Liverpool Publications of the Hartley Botanical Laboratories No 7 Studies in Advancing Sterility, Part 5 The Theory of the Leguminous Strobilus By Dr John McLean Thompson Pp 79 (Liverpool) 8s
- Royal Botanic Gardens, Kew Bulletin of Miscellaneous Information Appendix 2 List of Seeds of Hardy Herbaceous Plants and of Trees and Shrubs Pp 59 106+iv (London H M Stationery Office) 1s net
- Empire Marketing Board Imperial Sugar Cane Research Conference, London, 1931 Report of Proceedings Pp 171 (London H M Stationery Office) 2s 6d net
- Forest Department, Trinidad and Tobago Leaflet No 3 Report of an Experiment on Air Seasoning of Native Timbers Pp 22 Leaflet No 4 Forest Trees of Trinidad and Tobago with Special Reference to their Timbers Pp 43 6d (Trinidad Government Printing Office)
- India Meteorological Department Scientific Notes, Vol 4, No 33 Temperature Changes in Calcutta Thunderstorms By V V Sohoni Pp 17 34 (Calcutta Government of India Central Publication Branch) 10 annas, 1s
- International Research Council Third Report of the Commission appointed to further the Study of Solar and Terrestrial Relationships Pp v+132 (London Prof S Chapman, Imperial College of Science)
- Transactions of the Geological Society of Glasgow Vol 18, Part 3, 1928-1931 Pp iii+361 651 (Glasgow) 10s
- Proceedings of the Liverpool Geological Society Session the seventy-second, 1930-1931 Edited by D A Allan Part 4, Vol 15 Pp xiii+267-338 (Liverpool)

- British Industries Fair, 1932, Olympia, W 14, Feb 22 to Mar 3, White City, W 12, Feb 22 to Mar 5 Organised by the Department of Overseas Trade Special Overseas Advance edition Pp xi+464+Ad 178+Ad xiv (London Department of Overseas Trade) 1s
- Leeds University Appointments Board Report on the First Ten Years' Work of the Board Pp ii+8 (Leeds)
- Quarterly Journal of the Royal Meteorological Society Vol 58, No 243, January Pp 88 (London Edward Stanford, Ltd) 7s 6d
- Review of Agricultural Operations in India 1928-29 Pp v+251+14 plates (Calcutta Government of India Central Publication Branch) 3 2 rupees, 5s 6d
- Department of Scientific and Industrial Research Report for the Year 1930-31 (Cmd 3989) Pp iv+136 (London H M Stationery Office) 8s net
- Publications of the Dominion Observatory, Ottawa Vol 10 Bibliography of Seismology No 11 July, August, September 1931 By Ernest A Hodgson Pp 177-190 (Ottawa F A Acland) 25 cents
- Dove Marine Laboratory, Cullercoats, Northumberland Report for the Year ending June 30th, 1931 Edited by Prof Alexander Meek Pp 45, (Cullercoats) 5s
- Board of Education Educational Pamphlets No 87 Memorandum on the Possibility of increased Co operation between Public Schools and Public Educational Institutions Pp 45 (London H M Stationery Office) 9d net

## FOREIGN

- The Memoirs of the Imperial Marine Observatory, Kobe, Japan Vol 4, No 4, November Pp 278 326 (Kobe)
- Proceedings of the American Academy of Arts and Sciences Vol 66, No 10 Radioactive Disintegration applied to the Measurement of Geologic Time illustrated by application to the Wilberforce Uraninite By Gerhard Kirsch and Alfred C Lane Pp 367 379 60 cents Vol 66, No 11 Bermuda during the Ice Age By Robert W Sayles Pp 381 468 +13 plates 2 dollars Vol 66, No 12 On the Apsidal Motion of a Faint Eclipsing Binary By Harlow Shapley Pp 469-477 35 cents (Boston, Mass)
- Geological Survey of China Geological Memoirs, Series A, No 9 The Geology of the Tsinlingshan and Szechuan By Y T Chao and T K Huang Pp viii+230+19 plates+Atlas (Peking)
- Report of the Secretary of the Smithsonian Institution for the Year ending June 30, 1931 (Publication 3128) Pp vii+159 (Washington, D C Government Printing Office) 20 cents
- U S Department of Commerce Coast and Geodetic Survey Triangulation (Serial 529) Pp 20 (Washington, D C Government Printing Office)
- University of California Publications in American Archaeology and Ethnology Vol 28, No 4 Ethnography of the Yuma Indians By C Daryll Forde Pp 83-278+plates 49 57 (Berkeley, Calif University of California Press, London Cambridge University Press) 2 25 dollars
- Rubber Research Institute of Malaya Bulletin No 3 The Root Disease Problem on Old Rubber Areas in Malaya By A Sharples and A R Sanderson Pp ii+43+2 plates (Kuala Lumpur) 1 dollar
- Bulletin of the Shanghai Science Institute Vol 1, No 6 Upper Carboniferous Brachiopods from North China By Kinemon Ozaki Pp 205+15 plates (Shanghai)
- Journal of the College of Agriculture, Imperial University of Tokyo Vol 11, No 3, November 20th Pp 241 357+plates 16-24 (Tokyo Maruzen Co, Ltd) 3 00 yen
- Proceedings of the Imperial Academy Vol 7, No 9, November Pp vii+xxv+331 368 (Tokyo)
- Bulletin of the Earthquake Research Institute, Tōkyō Imperial University Vol 9, Part 4, December Pp 387-513+plates 44 56 (Tōkyō Iwanami Shoten) 1 70 yen
- Bulletin of the American Museum of Natural History Vol 63, Article 2 Anomuran, Macruran Crustacea from Panama and Canal Zone By Lee Boone Pp 137 189 (New York City)
- Conseil Permanent International pour l'Exploration de la Mer Journal du Conseil Vol 6, No 3, Décembre Rédigé par E S Russell Pp 355 524 (Copenhagen Andr Fred Høst et fils) 4 50 kr
- Transactions of the San Diego Society of Natural History Vol 7, No 4 The Cool-water Timms Point Pleistocene Horizon at San Pedro, California By Alex Clark Pp 25 42 Vol 7, No 5 A New Species and a New Subspecies of Pocket Gopher By Laurence M Huey Pp 43 46 Vol 7, No 6 A New Meadow Mouse from Lower California, Mexico By Laurence M Huey Pp 47-50 (San Diego, Calif)
- The University of Colorado Studies Vol 18, No 4 Pp 177-282 (Boulder, Colo) 1 dollar
- U S Department of Agriculture Circular No 204 An Air-Pressure Extension Brush for applying Creosote to Gypsy Moth Egg Clusters By C W Collins and J V Schaffner, Jr Pp 8 (Washington, D C Government Printing Office) 5 cents
- Reprint and Circular Series of the National Research Council No 102 Directory of Research in Child Development Compiled by J Allan Hicks Pp 74 (Washington, D C National Academy of Sciences) 50 cents
- Meddelande från Lunds Astronomiska Observatorium Serie 1, Nr 127 Tätigkeitsbericht der Sternwarte Lund in der Zeit von 1893 bis 1930 Von Knut Lundmark Pp 23 Serie 1, Nr 128 Über eine Periodenamplitudenbeziehung und eine Helligkeitsamplitudenbeziehung für anagalaktische und galaktische Cepheiden Von Knut Lundmark Pp 25 Serie 2, Nr 61 Über unregelmässige Störungen bei einem Cephe Veränderlichen Von Walter E Bernheimer Pp 34 Serie 2, Nr 60 On the Question of the Zero Point Determination in the Magalactic Distance Scale By Knut Lundmark Pp 23 2 00 kr (Lund)

## CATALOGUES

- B D H Vitamin Products Avoleum, Radiostol, Radiostoleum, Radiomalt Pp 8+11+14+11 (London The British Drug Houses, Ltd)
- Catalog and Price List of Eastman Organic Chemicals Twenty-third edition Pp 104 (Rochester, N Y Eastman Kodak Co)
- Refractories Bulletin No 1, January Pp 4 (Bonnybridge John G Stein and Co, Ltd)





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*Editorial and Publishing Offices*

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## Co-ordination of Scientific Digests.

FEW matters are more disturbing to the specialist in science and technology than the increasing number of scientific and technical periodicals which are published each year. The World List of Scientific Periodicals issued in 1927 contains nearly 25,000 entries and is already out of date. Reliable estimates in 1931 indicate that about three-quarters of a million scientific and technical papers are published every year in some 15,000 current periodicals, and there are as yet no signs that the limit of expansion has been reached. The task of keeping in touch with all that is published even in a limited field is becoming a physical impossibility to the most rigid specialist, and industrial and scientific research are alike more and more dependent upon the abstracting bureaux for directing their attention to the papers which it is essential that the investigator on particular problems should read.

This tendency in itself throws a heavier responsibility on the various abstracting bureaux, for more depends upon their efficiency and vigilance. At the same time, the multiplicity of publications has greatly increased the strain on the meagre resources of the societies maintaining such services, and in recent months the British Bureau of Chemical Abstracts has been compelled by financial stringency to introduce abbreviations into its abstracts. Opinion is strongly held in some quarters that the innovation has introduced ambiguity and diminished the utility of the abstracts, but it is doubtful whether in the present circumstances the Bureau could as the alternative have raised the price of its Abstract publications.

The seriousness of the situation is fully realised by the officers of the Bureau, and a full discussion was held in May 1930 by the Chemical Engineering Group of the Society of Chemical Industry, at which Sir Frederic Nathan presented his paper on the international abstracting of scientific literature, outlining a scheme based on each country abstracting its own literature and the use of the International Decimal Classification for classification. The scheme was considered again at the conference of the International Institute of Bibliography at The Hague last August, and again by the Association of Special Libraries and Information Bureaux at its annual conference at Oxford in September. Mr H T Tizard, president of the latter Association, had already convened a representative conference at the Imperial College of Science and Technology in July for the informal discussion and interchange of experience on problems of preparing

and utilising abstracts of scientific and technical literature

The subject is one that bustles with difficulties, and co-operation even between the British and the American abstracting services is by no means simple to organise. It is clear, however, that the magnitude of the existing and rapidly increasing mass of scientific literature requires more systematic methods for its abstracting and classification than have been applied in the past. It may be that definite steps must be taken towards a comprehensive world scheme, even if it is only in one or two limited fields such as chemistry that definite proposals are possible in the near future. On the other hand, it is possible that, so far from the various technical abstracting services which at present overlap with scientific organisations like *Science Abstracts* and the British Bureau of Chemical Abstracts becoming merged in the latter, the scientific bureaux themselves may be divided and the abstracting of applied science be arranged by industries and not by sciences. It is not unlikely that more generous financial support might be received from industries for such schemes apart from the possibilities of co-operation with the efficient technical abstracting services which are already maintained by some industrial firms with large research departments. It is significant that the bulletins issued by the National Committees of the World Power Conference represent the first successful attempts at international bibliography.

Progress in any direction without overlapping and waste of effort is by no means easy, and in the meantime the danger of research work being duplicated in different parts of the world for lack of prompt and adequate means of exchange of information continues. With the idea of minimising the waste of scientific and technical effort in this way, apart from facilitating the exchange of scientific thought, a committee of scientific advisers, set up by the International Committee on Intellectual Co-operation, has considered the co-ordination of scientific bibliographies. With the object of assisting in the compilation of authoritative and complete bibliographies, the committee has adopted a recommendation that no scientific papers should be published which do not contain at the beginning or end analytical summaries compiled by the authors to facilitate the reading of the work or memorandum in question. The committee expressed the further opinion that the use of summaries should be extended to the reports of academic bodies, excepting very short articles or publications which are themselves in the nature of summaries.

The committee rightly insists that such summaries should conform to precise rules, failing which they lose most of their usefulness, and the rules recommended cover an exhaustive index of the subject, indicating new methods and results even though unconnected with the general subject of the paper as well as the conclusions and numerical data of general importance. A length four to eight per cent of that of the article is suggested.

This recommendation has been communicated to the Royal Society by the International Committee, with a request that it should be brought to the notice of all scientific organisations and editorial bodies responsible for the publication of scientific papers and communications in Great Britain. The council of the Royal Society, while generally favourable to the recommendation and its purpose, did not commit itself to the recommendation of the adoption of the proposed rules in their exact detail, but expressed the opinion that the recommendation could most usefully be brought to the notice of those concerned in the columns of NATURE.

It is obvious that original papers of the type to which the recommendation mainly relates are rarely published in NATURE. Nor are the summaries or reviews of research work included in our pages usually of sufficient length to justify even the enumeration of subjects proposed by the recommendation. There can, however, be little doubt as to the usefulness of providing an adequate summary with all scientific papers. Its value has already been demonstrated by the practice of providing an abstract of German, French, or English with the papers published in the Czechoslovakian, Rumanian, and similar scientific journals since the War. These summaries have greatly assisted in making more widely known the valuable research work being carried out in these countries in spite of the language difficulty.

The major criticism of the proposal will undoubtedly centre on the ability of the author to provide an adequate analytical summary even when furnished with rigid rules for its preparation. At the conference convened by Mr Tizard there was an interesting discussion as to the merits of authors as abstractors of their own papers, one delegate holding that the author, although the worst critic, was the best abstractor of his own work. Much would, however, undoubtedly depend on the editorial board to which the paper with its summary was submitted, for, apart from wide variations in the capacity of individual scientific workers to summarise or abstract their own papers, there is

the ever-present danger that the specialist mind which can best indicate the immediate and specialised bearing of the paper may completely overlook the general bearing of the paper which it should equally be the purpose of the summary to indicate. Co-operation between the author and editor might do much to remedy any such defect.

With papers published in the lesser known languages, such as Russian, a further difficulty arises regarding the language in which the abstract should be published. The whole purpose of the recommendation would be defeated if the summary were not issued in a generally known language, and probably it should be limited to English, French, or German. This raises a further obstacle to the preparation of an author's summary. While the knowledge of a foreign language is often deplorably small among scientific workers, it is even rarer to find a scientific worker who can write clearly and concisely in a language other than his own. Much greater linguistic powers must be assumed on the part of authors of scientific and technical articles if the preparation of such summaries is to be left to their own unaided efforts, and present experience of the abstracts provided in foreign languages does not encourage the assumption.

The same difficulty is, of course, encountered in regard to Sir Frederic Nathan's scheme for international abstracting, but while the difficulty is acute it should not necessarily be insurmountable. The very wide variation in the merits of the technical and scientific papers which are published in different countries, and even in the same country, tends, however, to discourage the expectation of early success. If steps could be taken simultaneously to secure some general improvement in the standard required for the publication of a paper in a reputable scientific journal, some general discouragement of premature publication, the repression of a widespread practice, for which some countries are notorious, of publishing the same investigation two or three times over in different journals without acknowledgment, and the curtailment of the practice of reprinting papers in different journals in the same country, real progress should undoubtedly be achieved. The selection of material and the discarding of the useless or irrelevant which are so essential in special libraries or information bureaux must be adopted judiciously but widely as fundamental principles both in publication and in abstracting.

Meanwhile the urgency of the problem continues unabated, with its tale of wasted effort, time, and money in every branch of science and invention due

to lack of information as to previous work. Vast stores of information are still out of reach which, when brought into juxtaposition with related facts in the mind of the investigator, might stimulate the growth of further knowledge and the birth of new ideas. The recommendations of the International Committee at least deserve the serious attention and careful study of all who realise the gigantic problem which scientific and technical literature now presents, and how long overdue is a determined effort for reform.

### The Sphere of Chemical Embryology.

*Chemical Embryology* By Dr Joseph Needham  
In 3 volumes Vol 1 Pp xxii + 613 + 11 plates  
Vol 2 Pp xvi + 615-1253 + 3 plates Vol 3  
Pp xvi + 1255-2021 + 1 plate (Cambridge At  
the University Press, 1931) 105s net

THIS is in its way a classical book. It is true, as T. H. Huxley said, that "books are the money of literature, but the counters of science", so that the term classical has a somewhat different connotation in the two fields. It is rare for a scientific book to conserve its scientific as opposed to its historical value through the centuries or even through the decades. There are a few which have done so. The "Origin of Species", for example, is one, and Wallace's "Malay Archipelago" is another, to go back, no one can read Harvey's "De motu cordis" without gaining new insight into scientific method and, indeed, into the physiology of the circulation, while one may prophesy that in its very different way D'Arcy Thompson's "Growth and Form" will long continue to make its own appeal.

Most of the classics of science are, however, classical because they mark a stage, like Linnæus's "Systema Naturæ", open a door, like Mendel's papers, consolidate a position, like Wilson's "The Cell". Dr Needham's book falls into this last sub-category. It demonstrates the extent of ground won by the pioneers in this new field, defines its scope, consolidates one part with another, and proclaims to the world the title of this young branch of biology from now on to sovereign rights in a territory of its own.

Faced with the formidable bulk of its more than two thousand pages, the reviewer cannot begin better than by giving an outline of its contents. The work opens with a short theoretical part, in which various biological philosophies are discussed with reference to the possibility of chemical embryology existing in its own right, and, this granted,

to the best method of prosecuting its study. The views of Driesch, Rignano, Haldane, Lloyd Morgan, E. S. Russell are discussed, as well as the early vitalistic controversies and the long battle over preformation and epigenesis, and the section concludes with an exposé of that well-thought-out 'neo-mechanism' with which those who have read the author's "Sceptical Biologist" are already familiar.

Part II, comprising nearly two hundred pages, is an extremely able and detailed account of the origins of chemical embryology, which, it may be prophesied, will long remain the best history of the subject.

Part III constitutes the bulk of the work, the treatise proper. To it we will return, after noting the existence of Part IV, with a number of special appendices, and Part V, with a two-hundred-and-fifty-page bibliography (and this with citation only of the author and the journal, not the title of the paper), an ample index of subjects, and another of the animals referred to.

Part III is entitled "General Chemical Embryology", and includes twenty-four sections: The unfertilised egg as a physico-chemical system. Growth. Differentiation. Embryonic respiration. The biophysics of development. The general metabolism of the embryo—its energetics—its special metabolisms—of carbohydrates, of proteins, of other nitrogen compounds, of fats, of lipoids and other oddments, of inorganic substances. Then the rôle of enzymes, hormones, vitamins, and pigments in development. The resistance and susceptibility of the embryo—its serology and immunology. The biochemistry of the placenta, of the amniotic and allantoic fluid. The blood and tissue chemistry of the embryo, and finally hatching and birth, on which follow fifty admirable pages of epilegomena, summarising some of the more salient ideas which emerged from the fourteen hundred pages of Part III.

This will at least give some idea of the ample scope of these three volumes, and demonstrate that it is impossible for a reviewer to offer any adequate criticism of details in his 'thousand words'. It will be best to give some idea of the interesting contacts which Needham's discussion offers with other fields of inquiry, for, since the scientific analysis of ontogeny is perhaps less advanced than that of any equally universal and equally important characteristic of living things, we must expect that a thorough exploration of any single one of its aspects will reveal many new contacts and unsuspected points of view.

Let not even the morphologists imagine that the studies are immune. The theory of recapitulation for example (p. 1629), suffers somewhat of a sea-change at the hands of the chemical embryologists. Consideration of the 'cleidoic' or closed system for example, of birds and reptiles, leads to a number of interesting and important evolutionary suggestions, and the discussion of its 'uricotelic' metabolism, in which uric acid instead of urea (or ammonia) is the final product of nitrogen excretion, suggests the important reflection that the type of metabolism characteristic of a group may often have been determined by the metabolic exigencies of embryonic life—a view which links up with those more morphological ones of Garstang on the importance of larval characters as stepping-stones to new evolution.

The *Entwicklungsmechaniker* will find much to interest him, including a valuable theoretical discussion of the problem of differentiation, and perhaps the best balanced critique of Child's theory of axial gradients which has yet appeared. Needham concludes one of his sections with the remark that the prerequisite for real and rapid progress in the scientific analysis of ontogeny is the linking up of the results of chemical embryology and those of *Entwicklungsmechanik*. With this we can all agree, but may add that Needham himself has thrown out a number of suggestions which will be of value in bringing about the liaison.

The physiologist will find a great deal to interest him. In the past, physiology has had a distinctly confined scope. Just as its virtual restriction to a few terrestrial vertebrate types has made the vista opened up by comparative study of other organic types so very alluring, so its virtual restriction to adult function means that the conception, opened up by these volumes, of a physiological as well as a morphological ontogeny will provide an equally dazzling prospect of research. It is by stepping backwards into developmental problems that morphology and physiology are ceasing to be 'pure' and are becoming parts of a synthetic and truly general biology.

Among specific topics of physiological interest may be mentioned the successive predominance of carbohydrates, proteins, and fats in the metabolism of embryonic life, the different methods adopted by marine, fresh-water, and terrestrial embryos for obtaining mineral substances and water, the apparently universal peaked curve for intensity of metabolism during ontogeny, rising to a maximum and then declining, the difficult but fascinating problems concerning the energetics of embryonic life, and

the temporal succession of various physiologically important substances, such as enzymes, hormones, and antigens, during development

Those interested in growth will find in the section on increase in size and weight a valuable summary, critical and up-to-date, of the various theories on the subject of growth, while specialists in mammalian embryology are presented with a full account of the metabolism and functions of the placenta

The general biologist will all the time be adding interesting items to his store of facts and ideas. Among these subjects the following may be mentioned. The notion that the activity of free marine larvæ may be concerned less with disposal than with the necessity of bringing large volumes of water in contact with the tiny organism to satisfy its need for phosphorus. The fact that the dogfish embryo excretes its urea into its yolk, so retaining it for osmotic purposes. The possibility that the shortage of mineral salts in fresh water may have been one of the major factors limiting the colonisation of this element by marine groups. The fact that one and the same tissue grown *in vitro* shows marked metabolic differences according to the age of the embryo from which it is taken, but that these differences disappear with prolonged sub-culturing. The curious progressive decrease of the melting point of human fat with age. The existence of numerous extra-embryonic enzymes during the early development of the chick, and the fascinating puzzle of how their operations are controlled before the control can be taken over by the embryo. The concordance of chemical with general biological evidence as to the intensely critical nature of the processes associated with gastrulation. The presence of subsidiary 'hearts' in the bat's placenta. The fact that the existence of special hatching enzymes in teleosts causes a veritable race between hatching and death, in which a slight fault of timing may prove fatal. The 'anarchistic' growth of oxygen-starved chick embryos, and the dislocation of differentiation from growth by means of cold. The fact that the semi-lethal yellow gene of mice exerts three different effects at three widely separated points in time during development. The existence of two groups of processes in embryonic life, one (including growth and differentiation) the maximum intensity of which falls early, the other (including metabolic rate) with a maximum intensity falling late.

So we might continue, but enough has been said to show what a mine of interest and information is to be found in Needham's pages.

There are naturally some minor criticisms to be made. The problem of dedifferentiation, whether

in its own right or in relation to metamorphosis, receives very scant treatment. No attempt is made to link up the discussion of Child's axial gradients with the important concepts of morphogenetic 'fields' associated with the names of Gurvich, Weiss, Schotté, and Bertalanffy. The implications of recent work on mitogenetic rays for the regulation of cleavage rate are not mentioned. It is a pity that the interesting appendix on the metamorphosis of insects has not been supplemented by a comparison with that of amphibia. Needham's surprise at the failure of insects to develop a placenta is perhaps misplaced: its advantage would be small in organisms of such limited size.

If there is a general criticism to make, it is that the book is sometimes ponderous in treatment, notably in sections dealing with disputed points, where it often reads like a series of notes on individual papers. If brief critical summaries could have been provided at the end of each section, it would have been very helpful.

The work, however, remains a classic. It has vindicated the claims of chemical embryology to independent and fruitful existence, and marks another mile-stone on the road biology is taking in its transformation from a static to a dynamic science. Biologists are under a very real debt to Dr. Needham for his wide reading, his critical and constructive faculty, and his patient industry, which have issued in this fine work. J. S. H.

### Archæology of the Amazon Basin.

- (1) *L'Archéologie du bassin de l'Amazone*. Par Prof. Erland Nordenskiöld. (*Ars Americana*, 1.) Pp viii + 72 + 57 planches. (Paris: Les Éditions G. Van Oest, 1930.) 350 francs.
- (2) *L'ancienne civilisation des Barréales du nord-ouest Argentin (La Ciénega et la Aguada) d'après les collections privées et les documents de Benjamin Muniz Baretto*. Par Prof. Salvador Debenedetti. (*Ars Americana*, 2.) Pp 60 + 68 planches. (Paris: Les Éditions G. Van Oest, 1931.) 350 francs.

(1) **T**HIS large quarto volume, illustrated by fifty-seven plates, many in colours, is the first of a series devoted to the art of aboriginal America. The series is published under the auspices of an international committee which includes representatives, all well known in the archæological world, from France, Germany, Sweden, Brazil, and the Argentine Republic.

The theme of this, the inaugural volume, is the archæology of the Amazon basin, and the author is the distinguished Swedish anthropologist and

traveller, Baron Erland Nordenskiöld, director of the Goteburg Museum, who in 1929 was awarded the Huxley Memorial Medal of the Royal Anthropological Institute of Great Britain and Ireland

A work dealing comprehensively with the archaeology of this area is as welcome to students as it is difficult to prepare. The territory is vast, and huge tracts of it, owing to the dense forests, never harboured a sedentary population. The same conditions which hampered the development of arts and crafts have also hampered exploration, and the archaeology of this great region is very imperfectly known.

Baron Nordenskiöld has given us an admirable survey of the archaeology of the country covered by the Amazon and its tributaries east of the Andes, based on a study of early travellers and his own personal expeditions, illustrated by such specimens as have been rescued from the earth by the very few excavators who have faced the difficulties provided by climate and forest. Added to the investigations of previous explorers are the results obtained by Mr. Curt Nimuendaju, whose recent expeditions on behalf of the Goteborg Museum, combined with the collections secured by Baron Nordenskiöld himself, have provided that institution with what is probably the finest series of Brazilian antiquities in the world.

In sixty-three pages of text and fifty-seven plates the author has succeeded in providing not only material and guidance for future workers, but also a number of soundly substantiated theories. He shows fairly clearly that, of the three important tribes inhabiting the Amazon east of the Andes (the Arawak, Carib, and Guarani), the Arawak provided the predominant influence in art, an influence extending northward to the Antilles, and even, faintly, to Florida, and southward into Bolivia. The incised pottery of Marajo and the modelled ware of Santarem, in spite of the difference of technique, display the same artistic traditions, and these are echoed in the primitive ware of the districts populated, in historical times, by Caribs.

Little trace of the great Andean culture, the pre-Inca and Inca, can be discerned except in the extreme south of the region under review. What traces exist relate only to the north-western provinces of Argentina, where there seems to be some mingling of influences emanating both from the early Tiahuanaco Empire and the Arawak culture.

It is not too much to say that the text is a model of construction and commentary. It is short, and the conclusions which the author offers are drawn directly from the evidence at his disposal.

As regards the illustrations, which constitute so large a proportion of the work, whether coloured or monochrome, it need only be said that both publisher and printer deserve the most sincere congratulations on the part of all students of science and art.

(2) The second monograph of the series carries a melancholy significance, because the author, Salvador Debenedetti, perhaps the leading archaeologist of Argentina, died unexpectedly on his voyage home from Europe, where he had been attending the International Congress of Americanists in Hamburg as Argentine delegate, and had conveyed the invitation of his Government to the Congress to meet in La Plata in 1932. He therefore never saw the publication of a volume to which he had devoted much time and thought, and which fully supports his reputation.

Debenedetti's introduction, though short, provides an excellent picture of what is known of the archaeology of the north-west Argentine Republic, and the sixty-eight plates, admirably printed, are a storehouse of design for students of primitive American art. The volume is a very good companion to Baron Nordenskiöld's monograph, because it shows the twofold influences of Amazonian art and the art of the early Tiahuanaco period of the Bolivian highlands, the latter predominating. Further, it provides very clear indications of artistic affinity with the art of the Nasca valley in southern Peru, in which Amazonian influences are almost indistinguishable. The art of Nasca and the north-west Argentine are definitely akin, but the technique is different. The majority of the Nasca designs are painted in coloured slip, the majority of the Argentine designs are engraved, or incised.

A comparison of the artistic motives illustrated in the two volumes, combined with what is known of the art of southern Peru, suggests that the early centre was Tiahuanaco, the influence of which spread to the Amazon, northern Argentina, and southern Peru, with a reflex action on the part of the Amazonian tribes which affected Tiahuanaco and Argentina more than the Peruvian coast.

The illustrations are taken from the magnificent collections made by the Benjamin Muñiz Barreto expeditions between 1925 and 1929 in the province of Catamarca. The excavations undertaken by Sr. Muñiz Barreto have produced the largest and most notable series of ceramic and stone remains illustrating the archaeology of the region, and the publication of this, proportionally small, selection of his private collection will be welcomed by all students of American archaeology.



### High-Frequency Alternating Currents.

*High Frequency Alternating Currents* By Knox McIlwain and J G Brainerd Pp xiii + 510 (New York John Wiley and Sons, Inc., London Chapman and Hall, Ltd., 1931) 30s net

THIS is a remarkably good book "No claim is made for originality of most of the material, for the presentation of new results, or for an exhaustive treatment of the subject matter." This disclaimer in the preface is in exact accord with our estimate in reading through the text. Moreover, it is not improbable that a reader depending on this book for all his knowledge of the subject would fail to recognise a wireless set when it was put before him. Yet the very essence of quantitative high-frequency work is set down here in a well-ordered array, with just that orientation and emphasis which many of us have had, painfully and with labour, to develop in default of such guidance as the authors now offer to our happy juniors. There is a measured neglect of much of the secondary matter that has cumbered and disbalanced preceding textbooks, there is no running away from detailed expansion in cases where a superficial treatment has in many previous texts left the student with a stock of unjustified certainties to unlearn.

It is to be observed that the authors define 'high frequency' in a way which is, in fact, illogical and unusual, but corresponds to the requirements of the radio engineer, who is concerned not merely with the radio frequencies—20 kilocycles per second or above—which are the mail-vans of his communication system, but with the audible frequencies which are the postal packets containing the intelligence to be conveyed. Accordingly, "the term *high frequency* will be used to designate any frequency used in telephony and sound reproduction, in carrier telegraphy and telephony, and in radio telegraphy and telephony. [It] may then be applied to frequencies from twelve cycles to 300 million cycles per second."

The first three chapters, dealing with the general phenomena of high-frequency currents, of resonance, and of coupled circuits, are followed by the longest individual chapter in the book, sixty pages on "Thermionic Vacuum Tubes." This chapter contains an adequate analysis of the unloaded and loaded triode, starting from a discussion of the diode, and proceeding to the development of the equivalent circuit of the tube, touching perhaps more briefly than might have been desired—even in these days of screen-grid tubes—on the import-

ant subject of the 'input impedance' of the loaded triode. A more complete mathematical analysis of the action of tetrode and triode, allowing for grid currents and variation of amplification factors, occupies a further thirteen pages of appendix.

To the chapter on amplification, which is on sound normal lines, succeed two of the most valuable chapters in the book, those on modulation (18 pp) and detection (23 pp). The phenomena of cross-modulation and allied effects, which are rapidly assuming primary importance in reception problems, are not treated. The exhaustive treatment of the simpler demodulation problems, with full tabulations of the audio-frequency terms resulting from 'plate current detection' and 'grid current detection', will, however, prepare the student for more specialised work on the response of the detector to two or more modulated signal voltages simultaneously applied.

Other important chapters, equally characteristic of the outlook of the book, are those on electric wave filters (45 pp) and transmission lines (28 pp). This is almost the first appearance in a general textbook of a 'student's guide' to two comparatively recent importations from 'line practice' into radio practice. No entrant into radio engineering can afford to be ignorant of the enormous scope and flexibility of filter circuits, nor is it merely in the increasingly frequent interconnexion of radio and line links that transmission line theory is essential. The antenna array on which depends the economy and efficiency of a purely radio channel must be designed by the transmission line engineer. In both these fields the authors' treatment lays a solid foundation for further reading.

The chapter on electromagnetic waves develops the Maxwell equations and applies them to radiation from antenna systems. It is followed by a chapter on reflection and refraction, in which the treatment of attenuation of radio waves in transmission is less satisfactory than is most of the material in the book. The last chapter is devoted to a useful discussion on electro-mechanical systems, with special reference, of course, to the telephone receiver.

The defect mentioned in the preceding paragraph is of the less important class of sins of omission, the sins of commission, in the form of definitely misleading or erroneous statements, are gratifyingly few. In one respect, however, the book in general will offend the sensibilities of the non-American reader. The reader familiar with the *Bell System Technical Journal* will not require a bibliography to show how much the authors owe to that remarkably

fine and generous periodical, and will join the authors and the reviewer in offering full measure of gratitude and admiration to its enlightened publishers. But he will not willingly accept the implication, in text and bibliography of the work under review, that the eastern hemisphere ceased to contribute to the science of high frequency alternating currents in the early years of the twentieth century. Clerk Maxwell, Drude, J. J. Thomson, and Richardson do find their way into the references, but it would be chastening to feel that the most readily checked framework in the book is really "in drawing". Each chapter of the book carries at its end a very useful bibliography. These fifteen tabular bibliographies contain 121 references (some naturally duplicative, but here treated as independent). The references to American periodicals number 81, to English 1, to Continental nil. Of 39 book references, 30 are American, 6 English, 2 are to the English translation of Drude, the remaining 1 to Pedersen's remarkable work published in English *ab initio*. The gold has been re-interred, must the laurels be transplanted too?

#### Medical Statistics.

*An Introduction to Medical Statistics* By Hilda M. Woods and William T. Russell. Pp. x+125 (London: P. S. King and Son, Ltd., 1931) 7s 6d.

QUITE apart from the academic consideration that vital and medical statistics now form an obligatory part of the education of students seeking the University of London's diploma in public health, the demand for information about the methods of vital and medical statistics is increasing. The most casual reader of the newspapers is now aware that population problems are of serious practical importance and that the publications of the General Register Office cannot be ignored. It is scarcely an exaggeration to say that the recently issued preliminary report on the census of 1931 is one of the most sensational documents which has appeared for years, and that he who reads it intelligently will understand what is meant by saying that civilisation is in the melting pot.

In order to read vital-statistical documents intelligently, some technical training is required. Published manuals tend to fall between two stools; either they bewilder the ordinary reader with mathematical formulæ or they are couched in dogmatic terms which irritate him. Miss Woods

and Mr. Russell have avoided both these dangers. They make no claim to provide a complete treatise on statistical methodology, and, at the outset, warn the reader that he must consult larger books if he wishes to become a fully equipped statistician. But, within the compass of 125 pages and without dogmatism, they have given information quite adequate to enable the reader to peruse with understanding *any* official report on vital or medical statistics.

The first two chapters deal with the nature of the original material and its tabulation. These are followed by a short but sensible chapter on charts and diagrams. The next two chapters discuss estimates of population and the measurement of birth and death rates. The following four chapters are of a more general character, but the illustrations are drawn from vital-statistical data. The next chapter is a clear account of the principles involved in the construction of a life table, and the last expounds the root idea involved in the determination of a 'probable error'.

Here and there the printer has failed to cope with a subscript notation, but on the whole the format is good and the reader should have no difficulty in following the exposition. This book deserves a wide circulation. M. GREENWOOD

#### Short Reviews.

- (1) *Race as a Political Factor*. By Prof. J. W. Gregory. (Conway Memorial Lecture delivered at Conway Hall, Red Lion Square, W.C.1, on April 15, 1931.) Pp. 72. (London: Watts and Co., 1931.) 2s net.
- (2) *Race Mixture. Studies in Intermarriage and Miscegenation*. By E. B. Reuter. (Whittlesey House Publication.) Pp. vii+224. (New York: McGraw-Hill Book Co., Inc., London: McGraw-Hill Publishing Co., Ltd., 1931.) 12s 6d net.

EACH of these two books deals, though from very different points of view, with the question of the effects of contact between two or more races differing in physical character and in culture—a problem which to-day is probably of more importance for the future of the world than any other with which public policy is concerned in the countries affected.

(1) Prof. Gregory's Conway lecture has the practical end very directly in view. His remedy for the present situation and the avoidance of a greater danger in the future is segregation of the inferior race. His argument is that otherwise social absorption is inevitable in present conditions, and the product of crossing races so diverse as black, white, and brown, so far as we are able to judge from the biological evidence, is likely to be of an inferior type. Further, in communities in which white and coloured live side by side, the

coloured so reduce the wages of the white low-grade labour as to render even their minimum standard of living unattainable

(2) Prof Gregory's argument rests largely on the inferiority of the hybrid. To this Prof Reuter's book is a foil. He points out that the weakness of all argument about 'superior' and 'inferior' races is that, mistakenly, it makes culture a function of race. He then examines in considerable detail, in a number of essays, various aspects of the colour problem in the United States but with special reference to the position and achievement of the mulatto and the lesser degrees of negro blood. He shows that, so far from being inferior, these crosses have attained a very high degree of achievement. He makes one very interesting point which is apt to be overlooked. In the case of the parents of a very large proportion of these mixed breeds, so far as the individual is concerned, the black has been exceptional in physical character and intelligence, while the white has often been of a low type intellectually or morally.

*Die westfälische Sedimentation und die asturische Phase in der innersudetischen Mulde.* Von S. von Bubnoff. (*Fortschritte der Geologie und Paläontologie*, herausgegeben von Prof. Dr. W. Soergel, Band 9, Heft 29.) Pp. iv + 407-497. (Berlin: Gebrüder Borntraeger, 1931.)

PROF. BUBNOFF has made a valuable stratigraphical and tectonic study of the Westphalian sediments of the Inner-Sudetic Basin in southern Silesia with the view of determining the relative duration of the Asturian phase of orogeny. The basin lies between the crystalline rocks of the Riesengebirge and the Eulengebirge, and is otherwise bounded by Lower Palaeozoic phyllites or by Kulm. A geological map which accompanies the book shows the limits within this frame of the successive basins of sedimentation in Namurian, Westphalian, and Stephanian times.

It is pointed out that the exact determination of the time of an orogenic phase is only possible where the earlier and later sediments can be exactly dated. As a result of the detailed work in the region described, it is clear that the Asturian phase was not a single episode of concentrated movement, but the sum of a series of differential disturbances which occurred throughout Westphalian time. The maximum intensity of movement occurred not at the close of the Westphalian, as generally stated, but during the later part of Westphalian time. The direction of movement deviated considerably from the trends of earlier and later orogenic phases. The development of each successive basin of subsidence is found to be related to an orogenic event.

It will be realised from these results that the author has made a contribution to comparative tectonics of great importance. Similar conclusions are being reached elsewhere (for example, in the Pennines and adjacent coalfields, in Wales, and in various North American areas) from a careful scrutiny of the sedimentary and structural record, suggesting that adjustment to stresses is more nearly continuous than has hitherto been realised.

*The Electric Trolley Bus.* By R. A. Bishop. (The Specialists' Series.) Pp. xi + 193. (London: Sir Isaac Pitman and Sons, Ltd., 1931.) 12s. 6d. net.

THE Royal Commission on Transport has suggested that the tramways are "in a state of obsolescence". It suggested also that the petrol bus has advantages as compared with trolley buses. The author points out that there are many reasons which make the trolley bus the more desirable. For example, if the whole of the 14,000 tramcars in Great Britain were replaced by petrol buses, the coal industry would lose one of its most important customers. Assuming that an omnibus takes a gallon for every five miles travelled, there would be an additional consumption of about 87 million gallons per annum. From the point of view of national economies, therefore, it is necessary that the load on the generating stations be retained. This is done when the change is made to the trolley bus.

The modern electric trolley bus is not being installed merely to replace obsolete tramway systems, in some cases it is being put into service where petrol buses previously ran because it is more efficient and considerably cheaper to operate. It has to be remembered also that the city street passenger systems are largely owned by the public and should be operated on the most efficient lines for the benefit of the public. This book is to be commended. Good chapters are given on "The Changing Outlook" and "On the Future of City Transport".

*The Chemistry, Flavouring and Manufacture of Chocolate Confectionery and Cocoa.* By H. R. Jensen. Pp. xvi + 406. (London: J. and A. Churchill, 1931.) 27s.

ALTHOUGH "the captains and the kings depart", the world goes on eating chocolates, particularly in countries where alcohol is prohibited. Further, since science and the chemist have penetrated into the industry, there is an amazing store of accumulated technical knowledge in every branch of it. As to how far the best use of this is made by British industry is a question over which the author breaks a lance in his introduction, as a past chairman of the panel of the British Association of Research for Cocoa, Chocolate, Sugar Confectionery, and Jam Trades, he is well qualified for the task. It is disturbing to notice that he is so far critical of the condition of affairs in Great Britain as to state that the failure to make effective use of the laboratory is both limiting the scope of the younger men and definitely reacting on the class of men who enter the industry.

The book is essentially a reference manual. It deals in turn with cocoa, with chocolate manufacture, with ingredients such as fats, sugars, milk, agglutinants, flavours, colours, and analysis. It is clearly printed, contains ample tables and the usual necessary illustrations from plant manufacturers' catalogues. Such problems as bloom, both sugar and fat, which are the bugbear of the manufacture, and other difficulties arising out of improper storage of chocolate goods are discussed briefly.

### The Dehra Dun and Saharanpur Herbaria.

THE Saharanpur Botanic Garden, situated in the old North-Western Provinces, India, was at one time in the charge of the late Mr J E Duthie, who was responsible for placing the herbarium of that place in an exceptional position. This herbarium was transferred later to the Forest Research Institute, Dehra Dun. Mr Duthie left numerous manuscript notes on the herbarium, and with their aid, Mr R N Parker, forest botanist, has published an account of "The Herbarium of the Forest Research Institute" \*.

Mr Parker tells us "The Herbarium of the Forest Research Institute is composed of two very unequal portions, the larger being the herbarium of the Botanical Department of Northern India, usually known as the Saharanpur Herbarium, which was transferred to Dehra Dun in 1908 and amalgamated with the herbarium of the Forest School. Nothing is now known of the relative sizes of the two herbaria. The present collection was estimated to contain 222,000 sheets on 1st January 1929." This brings the existing position of the herbarium nearly up to date. But to many the chief interest of Mr Parker's account will be found in the concise history he gives of the Saharanpur Botanic Garden, and the long line of distinguished botanists who had more or less connexion with it. To those who are acquainted with the botanical and, it may be added, the forestry history of India, such names as Govan, Wallich, Royle, Falconer, Helfer, Griffith, Hooker, Jameson, and J L Stewart will take them back to the earlier work accomplished in the first half of last century. For this reason it is proposed to glance briefly at some of the more important passages in this history of botany and the Botanic Gardens at Saharanpur, with which the name of Duthie (an excellent portrait of whom is reproduced in the *Bulletin*) will be for all time associated.

The Botanic Gardens were established in 1816 on the site of an old native garden, which was much enlarged at various times. The first superintendent was Dr Govan, who collected plants mainly in what is now Sirmoor State in the Simla district. A part, if not the whole, of his collections were listed with others in Wallich's Catalogue. What became of the plants is unknown, but a collection of drawings was ultimately presented to Kew. Dr Royle succeeded Govan in 1823, and the results of his collections were published by him after retirement in "Illustrations of the Botany of the Himalayan Mountains", which appeared in parts during 1833-40. In this work, Royle describes the area he explored and refers to a herbarium of 3500 species. He took the bulk of this collection home with him, there being no facilities for housing it at Saharanpur. This herbarium after his death was actually sold, by auction in London, for 11s, and is believed to have gone to Russia! Royle, however, presented a set of his plants to the Linnean Society and many of his plants are now

at Kew, some having been sent to Hooker or Bentham and going to Kew with the herbaria of these botanists. That Dehra Dun to-day possesses some of Royle's plants is chiefly due to the fact that in 1876, Duthie found some bundles of the former's plants at Saharanpur, which were preserved.

Owing to his medical duties (as station surgeon Royle was unable to undertake any botanical tours for the first three and a half years of his tenure at Saharanpur, but from a letter he wrote, dated June 28, 1828, it appears that he explored part of the Siwaliks and the Dun plateau, went up to Mussoorie, where he established an experimental physic garden, and marched across to Simla and on to Kotgarh. In the following year he made a more extensive tour in this part of the Himalaya. Wallich was superintendent of the Calcutta Botanic Gardens, and in the previous year had made the first botanical visit to the great forests of the newly acquired Province of Tenasserim and made some considerable collections.

Dr Falconer succeeded Royle in 1831. His collections were augmented by his adopting Royle's method of sending natives to accompany caravans into the interior of the mountains. These collections, with the exception of a few bundles found by Duthie with those of Royle, were sent to the India House, London. They are referred to by Hooker in the preface to the "Catalogue of the Plants distributed at the Royal Gardens, Kew from the Herbaria of Griffith, Falconer and Helfer." Falconer was also a geologist and investigated the fossil Siwalik fauna. Both Helfer and Falconer followed in Wallich's footsteps and were sent to report upon, and collect in, the forests of the Tenasserim Province in 1838-39 and 1849 respectively, the unrestricted fellings in the teak of that region having begun seriously to alarm the Government and the Court of Directors.

Dr Jameson followed Falconer in 1842, retiring in 1876. He was not a botanist, but had the credit of establishing the tea industry in Northern India. During brief periods of leave, Dr J L Stewart (first conservator of forests in the Punjab, 1864, and author of "Punjab Plants") officiated for him in 1861, and Dr G King, afterwards superintendent of the Royal Botanic Gardens, Calcutta, in 1868.

Dr Duthie arrived in Saharanpur in December 1876 as superintendent of the Botanic Gardens, which post he held until April 1, 1887, when he became director of the Botanical Department of Northern India, he was then able to devote his whole time to botanical work until he retired in December 1902. The position of affairs on Duthie taking over his charge is thus described by himself: "On my arrival in Saharanpur I found the Museum (erected in 1859) filled with miscellaneous collections including animals, mostly birds, as well as many kinds of vegetable products such as fibres, drugs, etc., and in one of the glass cases sundry articles used in the manufacture of tea were exhibited. Other cases contained various rock specimens,

\* *Forest Bulletin*, No. 73. The Herbarium of the Forest Research Institute. By R. N. Parker. Pp. iii+10. (Calcutta: Government of India Central Publication Branch, 1931.) 5 annas, 6d.

including some of Falconer's original specimens of the Siwalik fossil remains of animals. The herbarium, such as it was, occupied a very subordinate position of the Museum, for, as the specimens were unarranged, unmounted, and for the most part unnamed, the collection could not in that condition be considered of any practical use to the public. The material consisted mainly of specimens collected by natives employed by Dr Jameson during his tours in connection with tea culture. There were also a few bundles of specimens collected by Royle and Falconer in various parts of North-West India and labelled in their own handwriting. These, however, were mere remnants and scraps of their original collections."

Reference to Mr Parker's article must be made for a study of the methods by which Duthie grappled with the position and built up the magnificent herbarium, ultimately to prove so firm a foundation upon which the Dehra Dun Forest Research Institute could build.

Reference has been made to the Dehra Forest School Herbarium. This was started by Mr Gamble, who became director of the School in 1890 and held the position for some ten years. To start this collection, Gamble presented a set of his own duplicates collected in Bengal and Madras. He collected assiduously during his stay at Dehra and received many contributions from forest officers and others. Duthie also contributed, and the in-

structors at the School, especially Upendra Nath Kanjilal and Birbal, collected many species of local trees and shrubs. Some private herbaria made by forest officers were also presented.

Mr Parker details some interesting facts in connexion with the earlier collectors and their direct or indirect influence on the present herbarium at Dehra Dun. The names include Roxburgh, Wallich, Strachey, Winterbottom, Griffith, Helfer, Hooker *fil.*, Thomson, Stocks, Dalzell (Bombay), Wight (South India), Thomson, Beddome (conservator of forests, Madras and Bombay), Falconer, and Jameson. Amongst later collectors are the names of Col Davidson, R.E. (Kumaon), Dr Aitcheson (Punjab and Afghanistan), Dr Goodenough (collection received from Kew), Sir D Brandis (greater part of herbarium received from Kew), Thwaites (Ceylon), Gamble, Lace (Punjab, Baluchistan, Burma), Sir H. Collett (Simla, North-West Frontier, and Upper Burma), C.B. Clarke, C.F. Elliott (conservator of forests, Punjab and North-West Frontier), A.V. Munro (conservator of forests, Hazara, Multan, Baluchistan), C.W. Hope (many ferns), W. Gollan (superintendent of the Botanic Gardens, Saharanpur, 1887-1904—many plants and mosses), W.A. Talbot (conservator of forests—Bombay plants), Cooke (College of Science, Poona), and Dr Lisboa (grasses). The Herbarium also contains series of plants obtained by foreign exchanges.

### Intelligence and Fertility \*

By Dr SHEPHERD DAWSON

INVESTIGATIONS have recently been carried out in Glasgow into the relationship between birth-rate and intelligence. Individual Binet tests were given to more than twelve hundred children of ages three to fourteen years, and the results of these tests have been correlated with the size of the family to which each child belonged. The population studied was slightly below average both socially and intellectually, among the fathers of the children there was a high proportion of labourers, and the average intelligence ratio of the children themselves was about ten per cent below the average of the general population.

Most previous investigations have been concerned with birth-rates only. In the present inquiry, information was collected also regarding fatalities and survivals, as regards the family to which a child belonged, there was a record of the number of children alive, the number of fatalities (ante-natal, natal, and post-natal), the ages of the children and the parents, and the number of years the latter had been married.

Correlations were calculated between the intelligence of the child and (a) the number of surviving children in the family to which he belonged, (b) the number born alive, (c) the number of births, and (d) the number of possible lives. The correlations were all negative and small, but significant,

that is, they showed a tendency for dull children to belong to larger families, they were slightly higher when only those families were considered in which the age of the mother was forty-five years or more, and the family presumably complete.

By dividing the children into three groups, 'bright', 'average', and 'dull', with intelligence ratios above 114, 114 to 85, and below 85 (100 being the normal), it has been shown that the birth-rate in the 'dull' group is about 50 per cent higher than in the 'bright', while in the 'average' group it is about 35 per cent higher. The fatalities (ante-natal, natal, and post-natal) are most numerous in the dulllest families and fewest in the brightest, yet, in spite of this, the proportions of survivors at the time of the examination remained about the same, there were about 50 per cent more 'dull' than 'bright', and about 40 per cent more 'average' than 'bright'. In the completed families the differences were greater.

The dulllest children obviously came from the largest families. If it be assumed, as is commonly done, that, on the whole, the intelligence of children is like that of their parents, then the dull parents have, on the whole, slightly more children than brighter parents.

The question how far these results are representative of what is happening in the population as a whole is clearly of importance. There is ground for thinking that in a group which contains a higher

\* Substance of a paper read before Section J (Psychology) of the British Association in London on Sept 24.

proportion of brighter intellects, the difference between the 'dull' and the 'bright' in respect of size of family may be greater, especially if sterility also be considered. An inquiry made some years ago in Glasgow into mortality-rates in 1789 poor families and 455 that were well-to-do, showed that when only families of more than one child were included, the average number of possible lives in the former was 5.6, while among the well-to-do it was 3.2. 'Well-to-do' and 'intelligent' are not synonymous terms, but there is a correlation between intelligence and social position, at any rate, up to the professional grade. Galton's inquiries into the family histories of 180 Englishmen who had distinguished themselves in science pointed in the same direction, the average size of the completed families of these men of distinction was almost exactly the same as that of the 'bright' Glasgow group.

These observations, then, show conclusively that the birth-rate is highest among the dullest members of the community, and that, in spite of their higher fatalities, they appear to be leaving a larger proportion of survivors, for at the time of the examination there was a higher average of surviving children in the dull and average groups than in the other. It is a problem for the future to determine what proportion of the children in each group will reach maturity and establish families of their own, for, unless there is a much higher fatality-rate among the present survivors of the duller groups, it is clear that the less intelligent elements of the population are increasing at a greater rate than the more intelligent.

The problem is one of national importance, for, although a slight difference, even a difference of one, between the families of the 'bright' and the 'dull' may seem a small matter, it is really serious, for the influence of a differential birth-rate is prob-

ably cumulative, since people of the same intellectual grade tend to intermarry, and there is the possibility that the fertility of each grade may remain the same from one generation to another.

The only source of consolation in the dismal picture is the consciousness of our profound ignorance of some of the important factors in the situation. We have still to find the proportion of children of each grade of intelligence who survive to establish families of their own, we have to find to what extent the dull and the bright intermarry, and whether the fertility of each group remains constant. It is well known that superior intellects sometimes spring from apparently mediocre stock, but we still require exact information regarding the extent to which they pass on their brilliance to their children, the common belief is that able parents have, on the whole, gifted children, that mental capacity is inherited like stature and other physical characters. Also there are different kinds of dullness to be distinguished, dullness that is the result of pathological conditions, accident and disease, and dullness that is the result of traits inherent in the stock, and we are very much in need of methods of distinguishing these and assessing their incidence.

There is, however, clear evidence that the duller elements of society have bigger families than the more gifted, and the little we know about the fatalities among them suggests that dullness is being bred rather than intellect. In view of the tendency of the State and private enterprise to do so much for the unfit, it is obvious that the question of the relationship between intellect and birth-rate is of more than academic importance and requires careful study, not only of the facts regarding birth-rate and survival, but also of the laws of mental inheritance, for, until these are known, speculation on methods of treatment is somewhat futile.

### Intellectual Co-operation.

AMONG the subjects considered by the Executive Committee of the International Committee on Intellectual Co-operation at its thirteenth session last July, was a report from the Committee of Scientific Advisers appointed in April. This Committee had discussed the general question of the manner in which international intellectual co-operation can assist the co-ordination or organisation of scientific work, and had surveyed the various scientific matters which had already come before the International Committee.

The latter included a scheme of Prof. Cramer for the organisation of the documentation of chemistry, which the Committee of Scientific Advisers considered is primarily a question for the International Union of Chemistry, and in the field of bibliography the Committee limited itself to recommendations that authors' analytical summaries should be provided with all papers in scientific journals—a subject discussed elsewhere in this issue (p. 181)—and that, in agreement with the scientific unions, national centres for scientific bibliography should be established where they do not already exist.

A proposal from the French National Committee regarding the unification of scientific terminology was regarded as within the competence of the scientific unions unless the latter should desire to utilise the relations already established between them and the International Committee. Similarly, the Committee of Scientific Advisers in its report endorsed the resolution of the Committee of Library Experts on the standardisation of printed publications. In view of the great advantages offered to the whole of the scientific world by the adoption of uniform rules for the classification of printed works and their utilisation, the immediate adoption of a standard format for periodicals and a bibliographical cover note was recommended.

The present financial position of the fund for the publication of Tables of Constants and Numerical Data was considered, and the great value of this publication was stressed. To assist in the solution of existing difficulties, an agreement between the International Committee on Tables of Constants and the Unions of Chemistry and Physics regarding the scientific and material



organisation of the publication is desirable, and it was recommended that, following agreement, the International Committee on Intellectual Co-operation should support the International Committee in action taken to secure regular contribution by all countries of the funds required for the publication.

In the discussion on this report, the value of international bibliography was stressed, although it was agreed that Prof Severi's scheme for the organisation of an international centre for mathematical bibliography is primarily a matter for the International Union of Mathematics. On the other hand, opinion was freely expressed that the Committee should extend its scope to include the bibliography of historical, economic, and social sciences. Against the latter proposal, M Poincaré and Prof J T Shotwell urged that the methods required for preparing bibliographies of the exact sciences are entirely different from those which should be adopted for historical, legal, and social sciences, requiring the co-operation of specialists in the various exact sciences. Accordingly, no advantage would accrue from such an extension of the Committee's scope. It was further suggested that the Institute should inquire of the national scientific unions what means they have of obtaining information on the scientific output of their countries, and thus providing a foundation for an international bibliography of each science.

In a slightly different field is the proposal by Prof Cabrera for a repertory of scientific laboratories. This proposal was unanimously approved by the Committee of Scientific Advisers, who requested the International Committee to have the present situation in the laboratories studied by the Institute from the point of view of the working facilities accorded to foreign professors and students and the practical means of making the existing facilities known. So far as Great Britain is concerned, this information is largely contained in the "Year-book of the Universities of the Empire", and it was suggested that application should be made to the national committees in all countries where such committees exist. The national com-

mittee would be able to state whether a suitable year-book is published in the country which, as such or in modified form, could serve as a repertory. Even members of the International Committee who had questioned the advisability of continuing the Committee of Scientific Advisers were strongly in favour of this proposal, which was embodied in a resolution, expressing the opinion that a repertory of scientific laboratories would be a valuable supplement to the publications of the Institute and that its preparation might immediately be considered by the Institute.

Apart from such questions bearing on the interdependence of research and instruction, the Plenary Committee discussed a number of other matters of great interest to scientific workers. The results of the consultation with governments regarding the draft convention for the protection of intellectual rights were reviewed together with the results of a meeting with representatives of legal institutions and, considering the scientific advisers' recommendation in favour of recognising the rights of the scientific worker, it was agreed to establish a committee of specialists to consider, with the assistance of the Institute, the whole of the replies received from governments, with any other documentary information collected, and to continue the action already initiated.

The publication of an international code of abbreviations of titles of periodicals has now been completed in regard to Slav terms, and a proposal for the preparation of an international bibliography of translations was approved, a preliminary technical study of the necessary methods by the Institute being recommended. The scientific study of international relations, university exchanges, the international use of the cinematograph in education, the utilisation of leisure in general education, popular arts, educational cinematography, etc., are other topics coming within the scope of the International Committee, which, with the assistance it is giving towards the reorganisation of education in China, illustrate its great potentialities for raising the general level of intellectual life.

### Obituary.

SIR ALFRED YARROW, BT, FRS

MY first long talk with Sir Alfred Yarrow was at Oxford in 1926, during the British Association meeting. Yarrow was at that time much interested in the relation between the world's output of gold and the cost of living index figure. A year later he read a paper on the subject at the British Association meeting at Leeds. I knew little of the matter, but I listened to him with interest. Later on, at Brighton, we discussed the future of scientific societies and technical institutions, and particularly the relative merits of short term donations and endowments for perpetuity. It was a most interesting talk, and we agreed that only in exceptional circumstances were perpetuity endowments wise, and that it was better for capital and interest on donations to be spent within twenty

years or so, and to leave subsequent generations to do their bit. Yarrow thereupon told me he proposed giving me £5000 for the British Association, the capital and interest on which were to be spent within twenty years. I asked him not to spoil a very pleasant evening by putting me in the position of a beggar, and suggested the donation could wait. He agreed, but shortly after midnight he wrote out a cheque, and handing it to me, said, "I have doubled it—there is £10,000."

This principle of giving money to be spent within twenty years appealed to Yarrow very much, and whenever he read an announcement of a gift stipulating similar conditions he sent me a line expressing his pleasure. From that time I dined with Yarrow some ten or twelve times every year, and my respect and affection for him grew steadily

stronger. One of the proudest moments of his life was when he was elected a fellow of the Royal Society, the proceedings of which he followed with great interest. He read a large amount of scientific and technical literature, familiarising himself with all the latest developments of modern engineering and many of the more important discoveries in biology and biochemistry. He questioned me for more than two hours in November last about Sir Frederick Gowland Hopkins' presidential address to the Royal Society, and the recent work on vitamins. Fortunately I was familiar with some of the recent literature, but it was evident that he had read much more.

Always Yarrow's mind was singularly clear, and not only could he describe in detail his early work on the Thames, on the Clyde, his experiences during the War, and the latest improvements in ship-building, but also he was continually inventing new devices. The road-rail car was developed in Yarrow's mind long before such a car was built, and he was convinced that it would be an important factor in the development of the railways. He also sketched out a project which, had he been a younger man, he would have developed. It was to facilitate rapid transport across Europe, and particularly across Canada. In the scheme he had in mind, transport was to be by aeroplane during the day and in train sleeping-cars by night. In his ninetieth year he travelled by aeroplane a great deal, and although slightly deaf, he listened whenever possible to the throb of the engines in order to detect any failure on the part of a sparking plug. He declared that he had never known one to fail. The development of the London-Brighton line greatly interested him—possibly because of his stay at Brighton for long periods—and he worked out from data given in the technical press the relative merits of traction systems using steam, the Diesel engine, and electricity, making various hypotheses on the increase in passenger traffic.

Yarrow's very early work in life has been insufficiently described, long before he built the water-tube boiler he studied the motion of hot water in glass tubes, varying the conditions of pressure and temperature and noting the size of bubbles and their effect on the circulation. I believe that no full description of this work was published, but he was so impressed with the readiness of application of the results that he never wavered in his faith in laboratory experiments. His work on the resistance of ships at high speeds in deep and in shallow water, on propellers, and on the balancing of engines, is well known, but little is known of the small-scale experiments subsequent to sea trials.

In simpler matters, too, Yarrow's mind was very active. I remember a long talk we had on the subject of medals awarded by scientific societies. He pointed out that they were invariably tucked away in a drawer or deposited at a bank, and were rarely seen by the recipient and practically never by friends. Yarrow was of the opinion that such medals should be a source of inspiration, and devised a simple kind of mount so that a medal could be

hung on a wall or supported on a mantel. Better still, the medal might be sunk into a nice block of clear glass and used as a paper-weight, so that it could be seen while the recipient was at work.

An illustration of a different kind is associated with the 'Compleat Angler' at Marlow, which he bought, so he said, to show that an engineer could run an inn. He supplied some of the waiters with pedometers, and was astonished to find that on one Sunday a waiter said he had walked twenty miles. With a twinkle in his eye he said "I took the pedometers away in case they should ask for an increase in wages." To help the waiters and also to lessen the irritation produced when guests desired attention, he caused to be placed on each dining-table a telescopic tube flying a small Union Jack with a notice at the base "When you want the waiter, raise the flag." I give this illustration to show that Yarrow was ingenious in the smaller matters of life as well as in the larger ones.

Yarrow was rarely deceived by anyone, but he told with great relish how his firm sold the *Caroline* during the Russian-Japanese war to two Irish gentlemen who paid an instalment in advance. Yarrow had previously constructed the high-speed yacht *Tarantula*, which was built on the lines of a torpedo boat, and its speed was thirty knots which was very high in those days. The *Caroline* was of similar design, but it was only completed to a certain stage so that it might be fitted up either as a torpedo boat or as a fast yacht. She left the Thames hurriedly, had an exciting passage through the Kiel Canal, and was delivered to a Russian admiral at Libau. I understand that representations were made by Japan, and *Punch* had a cartoon depicting Russia with Yarrow's *Caroline* under her arm, while Japan cried out, "I thought you weren't selling any." Yarrow admitted that both he and the *Caroline* were sold handsomely on this occasion, and as he humorously put it—"The *Caroline* got to Russia, but left many 'care lines' on me."

Yarrow's generous gifts to scientific bodies, the London Hospital, Girton College, and the Yarrow Home at Broadstairs, total more than £500,000. However, not all of his scientific friends can be fully aware of the very kind and generous heart he had. By accident I have come into contact with some who have benefited by his kindness, and I do not wonder at the very great affection with which he was held.

F. E. SMITH

#### MR. R. W. WILLIAMSON

WE regret to record the death of Robert Wood Williamson, anthropologist and former treasurer of the Royal Anthropological Institute, which took place on Jan. 12, at the age of seventy-five years. The son of Prof. William Crawford Williamson, F.R.S., he was born in Manchester in 1856. After being educated privately and at Owens College, Manchester, where he took a degree in engineering, he took up law. A successful career as a solicitor was brought to a close voluntarily in 1908, at the early age of fifty-two, in order that he might devote himself to scientific research.

Acting under advice, Williamson elected to visit New Guinea and the Solomon Islands as fields still offering scope for anthropological exploration. In 1910 he started out, and penetrated the interior of New Guinea, where he spent some time in the villages of the Mafulu, a mountain people until then practically unknown, recording their customs and magical beliefs. The scientific results of this expedition were published in "The Mafulu Mountain Peoples of British New Guinea", which appeared in 1912. The personal narrative of Williamson's experiences, including his travels in the Solomons, was published a short time after in "The Ways of the South Sea Savage".

For the remainder of his life, Williamson devoted himself to the study of the ethnology of Polynesia. He set himself to the stupendous task of preparing a complete critical digest of the literature relating to Polynesia, with special reference to the central area. This was a work for which Williamson's acute critical faculty and his legal training peculiarly fitted him. The first instalment appeared in 1924

under the title "The Social and Political Systems of Central Polynesia", a monumental work, very fully illustrated, which will be of permanent value as an authority on the formal aspect of Polynesian institutions. In the succeeding years he prepared a large amount of material for the work which was to follow. It may be hoped that this will be preserved for reference, if not for posthumous publication.

From 1912 until 1921, Williamson was treasurer of the Royal Anthropological Institute, afterwards becoming a councillor and vice-president. His judgment and his counsel, tempered by a lawyer's caution, but undismayed by difficulties, were highly valued by his colleagues.

In addition to his professional and anthropological activities, Williamson was devoted to gardening, and was at one time well known as an amateur grower of rock-plants and alpinists. The gardens on his estate became public property after he left Manchester for Witley, near Godalming, his summer residence in his later years.

### News and Views.

#### Tariffs and Imported Scientific Books.

ON Thursday, Feb. 4, after this week's issue of NATURE has gone to press, the House of Commons is to hear a statement from Mr. Chamberlain of the Government's proposals for the imposition of a ten per cent duty on all imported goods with certain exceptions, and for the setting up of a Tariff Commission. As imported goods include scientific books and periodicals, we hope that a member of the House, perhaps one of the universities' representatives, will have an opportunity of putting the case for their exclusion from the proposed ten per cent duty. The revenue that would be obtained from the duty on such books would be trifling, while the imposition of the duty would add to the cost of scientific literature. The high prices of Continental publications have been commented upon in our columns on several occasions, and any action which would increase them would result in a further reduction of the number of such works purchased by scientific societies or individuals. With works of fiction and other literature having large circulations, the probable result of a tariff would be the printing of the publications in Great Britain. Scientific and technical publications belong, however, to a different category, their circulation must always be so small that printing in Great Britain could never be contemplated as a business proposition. Their success always depends on international circulation. The only result of a tariff would be to prevent scientific investigators from consulting works dealing with their particular subjects, and thus to hamper progress.

#### Agricultural Industry

THE fall in the price of agricultural produce in all countries has resulted in a depression, so long continued and so intense, that it is certain to lead to far-reaching changes in agriculture itself. One of these is now becoming evident. Agriculture is rapidly

becoming an industry dependent on the market, and is ceasing to be a mode of living for the great mass of the people engaged in it. Both the farmer and the peasant sell most of what they produce and buy most of what they require. They are in business and the market dominates them. This fact must be kept steadily in view in considering the future development of the industry. Up to the present, the application of science to agriculture has been concentrated on the discovery of improvements which can be applied within the existing structure of the industry. This no longer suffices. What is now needed are fresh approaches to the problems of production and distribution. The framework of the industry itself must now be added to the list of subjects for investigation, so that new and novel means can be found to increase the output per unit of capital and per unit of labour. One such experiment, in which the small holdings of the peasant have been converted into large-scale communal farms, is now in progress in Russia. Proposals for experiments in new methods of farming have recently been before our own Parliament, but have had to be dropped for the present for reasons connected with the general financial position. Another obvious field of experiment lies in the educational domain, in extending the area from which the industry is recruited, so that new ideas and new points of view may rapidly gain adherents.

#### An Opportunity in India

AN interesting experiment in agricultural education and training is now being undertaken in India by Capt. J. W. Petavel, at Kamshet, near Poona. An area of five hundred acres of suitable land, close to the railway line between Poona and Bombay, in a good climate and provided with facilities for the development of irrigation, has been secured for trying out a novel method of preparing the sons of the Indian

intelligentsia for a career on the land. The project received the active support of the late Sir Ashutosh Mukherji, vice-chancellor of the University of Calcutta. The idea underlying the scheme is the creation of an educational and training colony in which practical work in agriculture can be combined with ordinary schooling. The boys will be prepared for the usual examinations, but will take part in the growing of crops and in the care of animals. This will be possible by reducing the time devoted to study by two hours daily, so as to make room for three hours' productive work in the fields. An effort is being made to collect the best boys possible and not to confine recruitment to any particular class. It is hoped, in this way, to attract to the land a number of youths who otherwise would merely increase the army of unemployed university graduates now such an acute problem in India. So far, all efforts in this direction which have been made in the past have failed. Great changes in the outlook of educated India are, however, now taking place. The dislike of manual work which, a quarter of a century ago, used to be such a marked characteristic of the higher castes is rapidly disappearing. There is at the moment nothing impossible in the idea of utilising large numbers of the new generation for the development of agriculture—India's greatest industry. All that is needed are successful experiments, followed in due course by effective publicity.

#### Prehistoric Cornish Village.

RECENT excavations in the prehistoric village of Chrysauster, ten miles from Penzance, under the Ancient Monuments Branch of the Board of Works, have added considerably to the evidence bearing on the age and character of one of the most interesting of 'British' settlements. The exploration of the large house opened up by Mr T. D. Kendrick in 1928 has been completed, two houses untouched by previous explorers have been completely excavated, and the round walls and floors uncovered by Borlase in 1873 and J. B. Cornish in 1897 have been cleared. This settlement, of which eight houses remain over-ground, with the remnant of its covered pathway of approach, entered by a granite arch, strongly recalls Skara Brae in the Orkneys, which has recently been excavated by Prof. Gordon Childe. The resemblance of the structures to those of Skara Brae is noted by the writer of an article on Chrysauster which appeared in the *Times* of Jan. 23, but the author would appear to be imperfectly acquainted with the character of the former site. He is in error in regarding Chrysauster as the only known example of prehistoric houses lining along either side of what is apparently a village street, for this arrangement is one of the most characteristic features of Skara Brae. The northern site is more primitive in character, and undoubtedly earlier than Chrysauster, of which the occupation is now dated by the pottery at from about the first century B.C. to the second century A.D. Some of the pottery suggests coarse imitation of contemporary Roman ware. The inhabitants were in part agriculturists, as is indicated by the lynchets

behind the village, and, in all probability, tin-streamers. Tin-slag and lumps of shapeless iron have been found, but little else indicative of the character of the material culture.

#### Regional Smoke Abatement.

AN observer looking from a height upon a town of considerable size, whether industrial or otherwise, cannot fail to be impressed by the foul condition of the atmosphere below him. A thoughtful person can scarcely fail to marvel at the indifference of the public to the nuisance and its inertia towards remedial measures. The law in Great Britain relating to smoke abatement has hitherto been administered by local authorities, and while in some cases it has been efficiently and successfully applied, in many others it is either a dead letter or applied only intermittently. Ample provisions exist, however, for the formation of statutory regional authorities by means of which uniform and more thorough administration over any suitable geographical unit may be instituted. So far, only one such authority, the Sheffield, Rotherham, and District Smoke Abatement Committee, has been set up. The Council of the National Smoke Abatement Society met at York on Jan. 26, and passed a resolution that local authorities be urged to combine for the purpose of setting up suitable statutory regional organisations for the administration of smoke abatement law, that, pending the formation of statutory regional organisations, local authorities be urged to establish advisory committees similar to those already in existence, and that the support of the National Smoke Abatement Society be given to such projects as will further these proposals. The Council's report shows that regional effort should be both more economical and effective than local action only, which is often rendered useless by the apathy of neighbouring areas.

#### Development of Lighthouses.

THE paper by D. Alan Stevenson on lighthouses which was read to the Royal Society of Arts on Dec. 2 and is published in the Society's *Journal* for Jan. 15 is of great interest. Mr. Stevenson comes from a family which for generations has been responsible for the lights and aids to navigation on the Scottish coasts. R. L. Stevenson was one of this family. Up to just over a hundred years ago a fire set on the top of a tower and exposed to all conditions of the weather still continued to be used in Britain. There are grounds for supposing that this method dates back to the twelfth century B.C. The author and his father have just been awarded a special prize by the Royal Society of Arts for their invention of the talking beacon, which combines radio and fog signal methods most satisfactorily. Many people estimate the distance of a flash of lightning by noting the time between seeing the flash and hearing the thunder. Dividing this time expressed in seconds by five gives a rough approximation to the distance of the flash in miles. Similarly, if we use fog signals and radio waves, the distance of the beacon from the ship is found in nautical miles by dividing by  $5\frac{1}{2}$ , the

radio waves travelling practically instantaneously and the air waves with the velocity of sound. In the Stevensons' method, the ship does not need a stop-watch, only a simple radio receiver and a loud speaker, and the mariner is told in speech his exact distance at any time from the beacon whenever he hears the sound of the fog signal through the air. Suppose, for example, that the third blast of the air fog signal is heard by the navigator when the loud speaker is saying 'one mile two cables', then this is the distance of the ship from the beacon. This system has been tried out successfully on the Little Cumbrae Island in the Firth of Clyde for the last twelve months (see NATURE, Jan 24, 1931, p 138).

#### Czechoslovakian Broadcasting Station.

ONE of the smallest countries in Europe, Czechoslovakia, now possesses the most powerful broadcasting station in the world. It is situated near Cesky-Brod, some twenty-two miles east of Prague, and is near the geographical centre of Europe. The power of the station is 200 kilowatts, which places it well ahead of the 158-kilowatt station at Warsaw, the next largest. The power is derived from a 15,000-volt three-phase high tension line by Hewittic rectifier valves in oil-filled tanks, duplicated so as to avoid the risk of a breakdown. It was opened on Nov 21, but the power is temporarily restricted. There are two antennae towers, each 492 feet high and spaced 820 feet apart. The building has a copper roof, which is connected to the ground by a copper conductor. As there is also a copper mesh screen on the floor of the radio room, all the radio apparatus is actually contained within a copper screen. Switching arrangements enable the station to be worked either at half or full power. In the former case six valves are used in the final stage, and in the latter twelve valves. An ingenious counting device indicates the number of times a valve has operated the circuit breaker, and hence the behaviour of each valve throughout its life is recorded. The engineer supervising the working of the transmitter sits at a 'monitoring desk'. He listens at various stages to the speech or music passing through the transmitter and so can compare the quality at each point. Push buttons enable him to start up the motor generator sets and the pumps for the water-cooled valves. The wave-length is 486.2 metres, and it will be interesting to listen to this station when it is operating at full power.

#### Constants of High Voltage Lines

IN a paper by J. S. Forrest published in the December number of the *Journal of the Institution of Electrical Engineers*, instructive data are given about the 'constants' of the high voltage lines used in the national 'grid' of Great Britain. Twenty years ago, engineers considered merely the coefficients of electromagnetic induction between neighbouring power lines. Experience, however, has proved that the electrostatic coefficients are in many cases much more important. If we have two parallel lines, one maintained at a high voltage and the other insulated, a voltage will be induced in the latter which can be computed when the mutual electrostatic coefficient between the two

is known. Many years ago, Kelvin and Maxwell showed how these coefficients could be calculated, and now engineers are beginning to adopt their methods. The experiments described in this paper show that when the pressures on the live wires are 132 kilovolts, the induced pressures on neighbouring 'dead' wires may sometimes be thousands of volts. Experiments were made by measuring the resistance of a fisherman's line when wet with river water, to find out whether he ran any risk of getting a serious shock if his line hit a live wire. It was found that the resistance of the line measured half a megohm per centimetre length, and it is inferred that, provided the line beyond his rod be several yards in length, there is little risk. We do not agree with this conclusion. A few years ago an engineer, thinking that a 33,000-volt line was dead and wishing to measure its sag, threw up his measuring tape, which was not of metal, over it, and was instantly electrocuted. We feel certain that a fisherman would run a very serious risk if his line touched a high tension wire at a river crossing.

#### Physiology and the 'Aura'.

AT the annual general meeting of the British Psychological Society on Dec 19, Prof. D. F. Fraser-Harris read a preliminary communication on a physiological study of the human 'aura', as it is called by occultists. By the 'aura', or 'human atmosphere', spiritists refer to a misty emanation which envelops the living body but cannot penetrate the clothes. Unless the body is naked, the aura can be seen only around the head, hands, and fingers. A typical experiment claimed to demonstrate the aura is as follows. Hold the outstretched fingers of the two hands touching one another at the level of the eyes about a foot or so in front of a black background, then after staring at the finger-tips for about fifteen seconds, slowly draw the fingers apart, when the aura in the form of 'greyish mists' will be seen streaming from the ends of the receding fingers. At the outset, Prof. Fraser-Harris said that he questioned the accuracy of these observations. What are actually seen are very dark or black areas corresponding exactly in shape to the fingers, and *interdigital* spaces filled with the 'greyish mists'. His explanation is that the black areas are the negative after-images of the pale fingers viewed against the black background and produced by temporal retino-cerebral induction. The grey mists of the interdigital spaces are the whitish after-images of the corresponding spaces of the black ground similarly produced by this form of induction. That the phenomenon is optical and subjective is shown by the fact that when the conditions are reversed the after-images are also reversed. It is claimed, therefore, that the so-called 'aura' of fingers (or hand or head) has nothing to do with vitality, and, under the conditions just observed, is the familiar negative after-image produced by temporal retinal induction.

#### The Appeal of Natural Beauty.

IN the third Rickman Godlee Lecture, delivered in University College, London, in October, Prof. G. M. Trevelyan directed attention to the call and claims

of natural beauty The appeal of beauty he analysed into elements partly æsthetic and partly belonging to the primitive nature of man, whose emotions react to the combined reality and allegory of the recurrence of natural events But the reaction is not the same for all nations or for all times Two hundred years ago the southerner looked upon the mountains of Scotland as "monstrous excrescencies" upon the face of Nature, the bare rocky summits of which "produce the disagreeable appearance of a scabbed head", and the "stupendous bulk, frightful irregularity, and horrid gloom" of which can stand no comparison with the verdant beauties of Richmond Hill There has been a great change in æsthetic appreciation since that day, due perhaps to the removal of dangers which were thought to lurk in the gloom of deep mountain glens, perhaps to an outlook modified by the moral and intellectual changes of modern civilisation In any event, beauty has become the "highest common denominator in the spiritual life of to-day", and the change calls for action, and speedy action, on the part of the State, if natural beauty is not to be hopelessly lost in ill-planned developments which deface the countryside The lecture has been published by University College, price 1s

#### Museum Service for Schools

THE Board of Education has taken to heart the hints and recommendations made in the reports upon museums by Sir Henry Miers and by the Royal Commission on National Museum and Galleries, and has prepared a pamphlet on "Museums and Schools", which ought to be of service to both (H M Stationery Office, 9d net) A short historical summary traces the gradual converging of the interests of museums towards education and of the schools towards making use of the treasures stored in museums, but the most useful part is the chapter dealing with possible methods of co-operation between the two The loan of exhibits, the sale of reproductions, the use of temporary exhibitions, the visits of school children generally to be conducted by the school-teachers themselves, are described as desirable means of inter-communication, and great stress is laid upon the interest of the teacher himself It is a strange thing that while the Ministry of Agriculture and Fisheries can publish attractive pamphlets about rats, pigs, or poultry, this Board of Education pamphlet upon museums should appear in an unusual and therefore awkward size ( $7\frac{1}{4}$  in  $\times$  5 in), in rather small print arranged in 76 numbered paragraphs, and in dingy grey covers, the whole suggestive of that depressing museum feeling against which the pamphlet tilts its final paragraph

#### Andrew Balfour Memorial Fund.

AN appeal has been issued for funds to establish a memorial to the late Sir Andrew Balfour It will be recalled that Sir Andrew died in January last year, shortly after his appointment as the first director of the London School of Hygiene and Tropical Medicine, and an appreciation of his life and scientific work appeared in our columns in the issue of Feb 21 (p 279) Sir Andrew Balfour will

long be remembered for the work he did in the furtherance of research and study in tropical medicine and hygiene When funds are available, it is proposed to place a simple and inexpensive monument in the School, and with the remainder of the sum received to establish an 'Andrew Balfour Memorial Fund' for the purpose of aiding students, preferably those from overseas, to pursue courses of study at the School Contributions should be sent to the Honorary Treasurer, Andrew Balfour Memorial Fund, London School of Hygiene and Tropical Medicine, Keppel Street, London, W C 1

#### Bats as Carriers of Rabies

A RECENT report to the Legislative Council of Trinidad states that twenty persons died in South Trinidad between 1929 and 1931 of a disease considered by Dr Hurst, of the Lister Institute, as due to the virus of rabies of a hitherto unknown type The infection was not conveyed by dogs, as the last case of dog rabies was in 1914 The report suggests that bats may be concerned, and the *Trinidad Guardian* observes that since the issue of the report, Dr Paman, the Government bacteriologist, says that he has found typical rabies symptoms in the brain of a Sangre Grande daylight bat—whatever species that may be It is possible that a vampire, in attempting to suck the blood of a rabid dog, might be snapped at and escape with some injury sufficient for inoculation, when it would naturally bite and infect bats of its own and other species, the gregarious habits of bats, several different species of which often select the same retreat, being particularly favourable to the spread of such infection

#### Simpler British Coinage

THE address on simpler British coinage delivered by Mr Harry Allcock before the Manchester Society of Chartered Accountants appears in full in the December issue of the *Decimal Educator* He proposes to divide the shilling into 10 pence and to issue the following coins The pound of 200 pence, ten shillings of 100 pence, five shillings of 50 pence, two shillings of 20 pence, one shilling of 10 pence, half-shilling of 5 pence, two pence, one penny, half penny, and farthing, 10 coins in all He points out that while this system simplifies our coinage to the nations to whom we wish to sell our products, it also allows us to continue to divide the pound into halves, quarters, eighths, sixteenths, and thirty-seconds if necessary No new names are required, and  $1\frac{1}{2}$  new pence would be equal to  $1\frac{1}{2}$  old pence Mr Allcock contemplates the introduction of the new system by Government decree raising the value of the present penny and requiring each holder of pence to return one-sixth of them to H M Treasury, but he sees the difficulty of enforcing this in the case of private holders

#### Coroner's Law in the United States

*Bulletin* No 83 of the National Research Council of the National Academy of Sciences, Washington, D C, is entitled "A Compendium of the Statute Law of Coroners and Medical Examiners in the United States" It has been compiled by George H Wein-



mann and is issued under the auspices of the Committee on Medico-legal Problems of the Council (Washington, D C, 1931 3 00 dollars) The publication appears to give an admirable summary of the law of the subject in the various States of the Union, illustrative cases being quoted when necessary It is of interest that, as in Great Britain, in four of the States and in Hawaii there are statutes providing for the taking of inquisitions by the coroner to determine the cause and origin of fires The taking of *ante-mortem* inquisitions by the coroner is provided for by statute in Connecticut and Rhode Island in the case of persons dangerously injured by criminal act, omission, or carelessness, and likely to die No reforms are formulated or suggested, but the opinion is expressed that the importance of the office of coroner will be greatly enhanced to the community if and when the incumbent of the office is required to be a person skilled in the science of medicine and pathology

#### Announcements

PROF R W WOOD, professor of experimental physics at the Johns Hopkins University, Baltimore, has been elected a foreign member of the Royal Swedish Academy of Sciences in recognition of his researches in the domain of physical optics

THE Council of the Institution of Naval Architects has awarded the premium for the year 1931 to Mr L C Burrill, University of Durham (Armstrong College), for his paper, "Seaworthiness of Collier Types" The premium will be presented at the beginning of the annual general meeting to be held on March 16 at the Royal Society of Arts, John Street, London, W C 2

THE Council of the Institution of Electrical Engineers has made the eleventh award of the Faraday Medal to Sir Oliver Lodge, honorary member of the Institution This medal is awarded not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the Institution The Council has elected Mr W. M. Mordey, past president, to be an honorary member of the Institution

THE annual general meeting of the Institute of Metals is to be held in London on March 9 and 10 Whilst the ordinary business of the Institute and the reading of fourteen papers will occupy the first day and the morning of March 10, the second afternoon's session will be devoted to a general discussion on "The Testing of Castings", to be opened by Dr W. Rosenham It is hoped that the discussion of such a practical question will interest all sections of the Institute's membership—those engaged in practical foundry work, engineering users of castings, and testing and investigation experts Visitors are invited also to take part in the discussion, and cards of invitation admitting to the meeting may be obtained on application to the Secretary, Mr G. Shaw Scott, 36 Victoria Street, Westminster, S W 1 A member-

ship election is due to take place on Feb 18 Those elected then will have the privilege of membership, not for the usual twelve months, but for the extended period ending June 30, 1933, and will be able to take part in the proceedings at the March meeting At the annual dinner to be held on March 9, the principal guest will be the Minister of Transport, Mr P. J. Pybus

WITH reference to the article entitled "A New Illumination Device for Microscopy" which appeared in NATURE for Dec 12, 1931, p 1010, we learn from Mr J. E. Barnard that similar objectives with a ring reflector were produced some time ago by Chapman and Aldridge, and were the subject of a British patent In no essential particular did they differ from those recently produced by Messrs. Leitz, who acknowledge the priority of the device of Chapman and Aldridge in their catalogue

CANADA is the leading country in the production of asbestos, most of her supplies being chrysotile A monograph on "Chrysotile Asbestos in Canada", by Mr J. G. Ross, has been published by the Department of Mines, Ottawa The volume, which is finely illustrated, deals with the physical and chemical properties of asbestos, its occurrence in Canada, quarrying and preparation for the market, the manufacture of asbestos products, and the commercial application of asbestos in various industries It concludes with an extensive bibliography of the subject.

THE sixteenth annual of the Paris Academy of Sciences has recently been published It includes a complete list of members, going back to 1795, giving brief biographical particulars, but an innovation occurs this year in the addition to entries of a letter indicating whether the Academy has records of autographs, portraits, medals, and busts of the person in question This year the Academy is paying particular attention to portraits, and it would be glad to receive any information concerning portraits of its members which are not already noted in the annual

PART 20 of the "Catalogue of Indian Insects", issued under the authority of the Government of India, has recently come to hand It deals with the family Alucitidae (Pterophoridae) or 'plume moths', and has been compiled by Mr T. Bainbrigge Fletcher, Imperial entomologist Altogether 78 species are listed with full synonymy, records of their distribution, and keys to the genera We trust that this useful work will be carried to completion notwithstanding the prevailing financial stringency

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A technical officer in the Admiralty Technical Pool for service in an Admiralty establishment, for work consisting chiefly of design and development in connexion with small precision mechanical and electrical apparatus—The Secretary of the Admiralty (C E Branch), Whitehall, S W 1 (Feb 26) A horticultural superintendent at the Swanley Horticultural College for Women—The Principal, Horticultural College, Swanley, Kent (March 18)

### Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

#### FitzRoy's Hydrographic Surveys.

WITH reference to the article in NATURE of Dec 26, 1931—pages 1065-1067—on "The Voyage of the *Beagle*", and more especially with reference to the paragraph on page 1068 on FitzRoy in "News and Views", it is not, I think, generally known either how much hydrographical surveying Capt. FitzRoy and his staff carried out during this five years' voyage from 1831 until 1836 or how long this work has stood.

First, it may be mentioned that in 1825 France and England undertook to survey the coasts of South America. The French examined the coasts of Brazil, the English those of Patagonia, Tierra del Fuego, Chile, and Peru.

The surveys carried out by the officers of the *Adventure* and *Beagle* from 1826 to 1831 embraced part of eastern Patagonia south of the Gulf of St. George, the greater part of the Strait of Magellan, Tierra del Fuego, and the west coast between Magellan Strait and Golfo de Penas. Thirty-three charts and forty-five plans of this work were received in the Hydrographic Department.

At the end of 1831, as we know, the *Beagle* again sailed from England to continue the survey and then to run a chain of meridian distances through the Pacific, Indian, and Atlantic Oceans, the ship being supplied with twenty-two chronometers for the purpose.

In 1832 three track charts (Cape Verde Islands to Bahia, etc.) and four plans (ports in the Azores, St. Paul's Rocks, etc.) were received at the Admiralty from the *Beagle*.

In 1833 seven charts of the south-east, south, and south-west coasts of Tierra del Fuego and two plans of parts of the Gulf of Penas were received of surveys made in 1832.

In 1834 nineteen charts and eight plans, also forty views of the surveys carried out in 1833, were received. These embraced the east coast of Patagonia from the south shore of the Rio de la Plata to the Gulf of St. George, including all ports.

In 1835 eleven charts, two track charts, and twelve plans were received, the areas of the surveys being mainly the east coast of Patagonia from the Gulf of St. George to Magellan Strait, the east coast of Tierra del Fuego, and the Falkland Islands, with plans of the ports and anchorages.

In 1837, after the conclusion of the *Beagle's* voyage, Capt. FitzRoy forwarded eighteen charts of the coast of Chile and thirty-four plans, eleven charts of the coast of Peru and eleven sheets of plans, embracing the whole coast from the Chonos Archipelago, 47° S, to the Guayaquil River, 3° S, and including all the ports and anchorages along the coast, also six charts and eight plans of the Galapagos Islands, and three charts and one plan of other islands in the Pacific Ocean.

It will thus be seen that during the period of this voyage no less than eighty-two coastal sheets, eighty plans of harbours, and forty views were received in the Hydrographic Department of the Admiralty from FitzRoy's surveys.

These surveys of the coasts of South America were used for the production of the Admiralty charts and

are mostly still the foundation of the present-day charts of this area.

The Argentine Government surveys have superseded them between the Rio de la Plata and the Gulf of St. George, but the charts of the east coast of Patagonia southwards, with the exception of the plans of the ports, still incorporate these surveys. The charts of Tierra del Fuego are also largely founded on the *Beagle's* work. In Magellan Strait the larger portion of the *Beagle's* work has been superseded, the Main Strait being taken from later British and foreign government surveys, but the adjacent waters are still partly from the *Beagle's* surveys.

For the west coast of South America from Magellan Strait to about latitude 40° S, that is, including all the Chonos Archipelago, Chiloe Island, etc., our Admiralty charts are compiled from the Chilean Government charts, and thence northwards to Valparaiso—approximate latitude 33° S—FitzRoy's surveys have been modified by later Chilean and other work, whilst only a few of our plans of Chilean ports and anchorages are now produced from the results of FitzRoy's work.

However, northwards from Valparaiso to the River Guayaquil, all the Admiralty charts of the Chilean coast and of all the Peruvian coast are from Capt. FitzRoy's surveys, and almost all the plans of Peruvian ports likewise.

This very large amount of work must have called for the greatest energy and zeal on the part of Capt. FitzRoy, his officers, and ship's company, more especially when one bears in mind the fact that these surveys were all carried out either from boats or from the ship under sail and with appliances which nowadays we would consider most crude.

Finally, as regards the chain of meridian distances round the world, it is recorded that these exceeded twenty-four hours by thirty-three seconds only, in a period of five years.

H. P. DOUGLAS,  
Vice-Admiral and Hydrographer

Hydrographic Department,  
Admiralty,  
London, S W 1,  
Jan 18

#### Specific Heats of the Diatomic Gases.

THE marked disagreement between the specific heats of the diatomic gases as found by sound velocity measurements and those calculated on theoretical grounds has for long been a source of perplexity to statistical mechanists, especially in view of the apparently simple nature of the assumptions required in the calculation. The easiest of these assumptions to attack would seem to be that of complete equilibrium between the various degrees of freedom of the molecule as the sound waves pass.

In two recent papers<sup>1</sup> Kneser has shown, by means of sound velocity measurements, that there is a lag in the transfer of energy between the vibrations of the CO<sub>2</sub> molecule and the other degrees of freedom much greater than that which has been hitherto suspected. In fact, he found that the period of relaxation for the vibration concerned was of the order of 10<sup>-5</sup> of a second, in place of the usually assumed period of the order of 10<sup>-10</sup> of a second. Now, if one admits a value of 10<sup>-5</sup> of a second for CO<sub>2</sub>, why should one not suppose that the period for oxygen may be of the order of 10<sup>-4</sup> of a second? Unless we are to disregard the sound velocity results *in toto*, we must make some fundamental alteration to the theory, and this seems to be the easiest to make. I find that the results of

Shilling and Partington<sup>2</sup> for oxygen and nitrogen can be accounted for if we assume the following values for the relaxation period of the vibrations

| Temperature | Relaxation Period in Sec |                       | Transparency Coefficient |          |
|-------------|--------------------------|-----------------------|--------------------------|----------|
|             | Oxygen                   | Nitrogen              | Oxygen                   | Nitrogen |
| 0° C        |                          |                       | 370                      | 8600     |
| 300° C      | $1.0 \times 10^{-4}$     |                       | 19.5                     | 58       |
| 600°        | 1.2                      | $0.88 \times 10^{-4}$ | 11.1                     | 20       |
| 900°        | 1.1                      | 0.92                  | 9.4                      | 12.5     |
| 1200°       | 1.0                      |                       | 7.9                      | 10.3     |

\* At room temperature the vibration comes in so little that the expected effect is smaller than the probable errors of the sound velocity determinations, and I have not included values for the relaxation period for 0° C.

If the period really is as long as this, there must be considerable absorption of the sound energy at the frequency at which the velocity is varying most rapidly. This frequency would be round about 1400 vibrations per second for both oxygen and nitrogen, according to the above results, and in the table are given values which I have calculated for the number of wave-lengths which the sound should travel before the amplitude is reduced to  $1/e$  times its initial value. It will be seen that the effect should be easily measurable at the higher temperatures, but is slight at room temperatures, so that the measurements which have been carried out at these temperatures do not tell us much.

The obvious methods of attack are the measurement at the higher temperatures of the velocity of sound over a considerable range of frequencies, and of the absorption of the sound energy. A more direct, if experimentally difficult, method depends upon photographing the ultra-violet absorption spectrum of oxygen as it is coming out of a cylinder at high pressure and temperature and noting the relative intensities of the various lines and bands. I hope to carry out this experiment shortly, and will not say more about it here.

It may be pointed out that determinations of the specific heat of oxygen carried out by means of a flow method,<sup>3</sup> in which the heating of the gas took about a quarter of a second, gave results nearly in agreement with theory, whilst the adiabatic expansion experiments of Eucken and Lude,<sup>4</sup> where the cooling was more rapid, gave results intermediate between the theory and the sound velocity results.

Finally, it is interesting to refer to a paper by Zener,<sup>5</sup> in which he points the way to calculation on wave-mechanical principles of the chance that a molecule will give up its vibrational energy in a collision. At the end of the paper he states that "for a typical case of collisions between diatomic molecules, where one molecule has one quantum of vibrational energy", the chance of transfer in a given collision is about  $2 \times 10^{-5}$  at 0° C. This we may compare with the value for the probability of the transformation of the vibrational energy (which should be considerably less) calculated from the relaxation period given above for oxygen at 600° C, which is  $0.5 \times 10^{-5}$ .

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<sup>1</sup> *Ann der Phys*, 41, pp 761, 777, 1931

<sup>2</sup> *Phil Mag*, 3, p 273, 1927; 6, p 320, 1928; 9, p 1020, 1930

<sup>3</sup> *Proc Roy Soc A*, 133, p 492, 1931

<sup>4</sup> *Z physik Chem*, B, 5, p 413, 1929

<sup>5</sup> *Phys Rev*, 38, p 277, 1931

### Surface Convection and the Distribution of Temperature near a Heated Surface.

LAST summer we took some temperature measurements under the steady conditions prevailing at the epoch of diurnal maximum temperature above an asphalted road where inferior mirage could be seen on any clear day. The temperature variation with height above a hot surface was shortly afterwards measured also in the laboratory. The lapse-rates were of the order of 20°-30° C per cm in the first centimetre, and of the order of 1°-2° C per cm at higher levels near a heated surface. The observations showed that there was (1) a 'skin layer' within the first centimetre, and (2) a 'surface layer' extending up to about 20 cm above the hot surface. The variation of temperature above these layers is practically negligible compared to the much larger variations below.

Taking into account the balance in an elementary layer between the heat received by convection processes and the net loss of heat by radiative processes, the following expression was derived

$$\phi = \phi_0 \frac{\sinh \alpha(h-z)}{\sinh \alpha h},$$

where  $\phi$  is the variable part of the temperature,  $\phi_0$  and  $h$  are constants, and  $\alpha$  is a constant equal to  $\sqrt{16\sigma\theta_0^3/k}$  involving the effective absorption coefficient of water



FIG 1

vapour  $a$ , the Stefan-Boltzmann constant  $\sigma$ , the convective conductivity  $k$ , and  $\theta_0$  the constant part of temperature. The temperature distribution observed above the road as well as in the laboratory experiments agreed with the above expression.

The nature of the turbulence near a hot surface was studied experimentally by us in detail. The space above a heated surface kept inside a smoke chamber provided with observational glass windows was illuminated by a concentrated beam of sunlight. Ammonium chloride or sulphur fumes were used. It was found that, just as in Aitken's and Lodge's experiments, there was a dark, dust-free layer above

the hot surface. The heated dust-free air was found to shoot up into several tongues of ascending air, these dark columns which conveyed the heat upwards travelled several centimetres upwards, but while their base near the hot surface was 1.5-2.5 cm broad, their width very rapidly decreased towards the apex. The dark columns develop and move about in a random manner. The corresponding downward movements of the cold air can also be observed. These movements are associated with vortices excited by the uprush of the hot air. The photographs reproduced in Fig. 1 give a rough idea of this phenomenon. In the permanent dark space above the surface it is likely that the heat conductivity is of the order of molecular conductivity, as suggested by the work of Prandtl and Langmuir.

Our results are being published in two articles in the *Indian Journal of Physics*, Calcutta

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Poona, 5

### Gill-Morell and Barkhausen-Kurz Oscillations

In the production of ultra-high-frequency oscillations by means of triodes with positive grid, it has been apparent that there exist two distinct types, Gill-Morell oscillations, the frequency of which depends solely on the external circuit of the valve, and Barkhausen-Kurz oscillations, the frequency of which

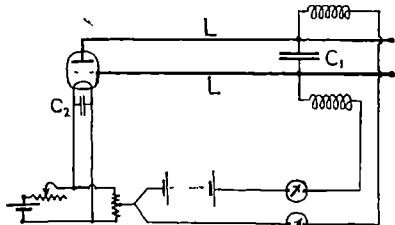


Fig. 1—Apparatus for production of electron oscillations.  $L$ ,  $L$ , Lecher wires,  $C_1$ , movable bridge,  $C_2$ , blocking condenser

depends mainly on the operating voltages. In 1928 Hollmann<sup>1</sup> obtained results tending to indicate that the Gill-Morell oscillations are a modified form of Barkhausen-Kurz oscillations and are invariably of higher frequency.

In the course of an investigation into the effect of

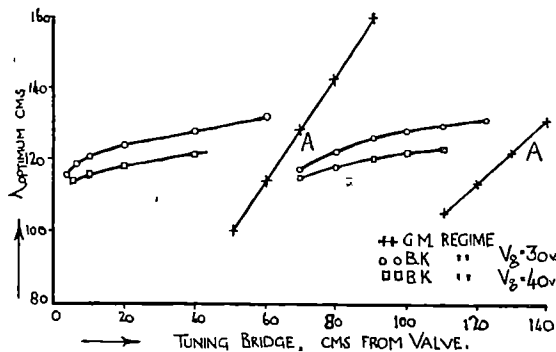


Fig. 2—Variation of wave-length with bridge position

varying the emission current, I have found that with one particular valve arranged in the normal way (Fig. 1) not only were Hollmann's results obtainable, but in addition true Gill-Morell oscillations as well. For most positions of the tuning bridge of the external circuit the value of the emission current decides

which type of oscillation is maintained. For higher values of grid voltage there are two values of emission current for optimum maintenance of the Barkhausen-Kurz oscillations, the wave-length for the lower value of emission being slightly shorter than that for the higher value. This agrees with results recently published by Moore<sup>2</sup>.

A typical set of observations on the wave-lengths maintained at various bridge positions is shown in Fig. 2. For each wave-length the emission was adjusted for optimum maintenance. It will be seen that the Gill-Morell oscillations extend on both sides of the Barkhausen-Kurz range. The amplitude of both types of oscillations, as measured by the increase of plate current, reaches a maximum at points A, when the maintained wave-lengths of the two regimes approach equality.

It is hoped to publish further details of this investigation shortly.

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<sup>1</sup> "On the Mechanism of Electron Oscillations in a Triode", H. E. Hollmann, *Ann. Physik*, 86, 129, 1928.  
<sup>2</sup> "A Particular Case of High Frequency Electron Oscillations", W. H. Moore, *Can. J. Res.*, 4, 505-516, 1931.

### Air Column Resonances and Symmetrical Modes of Truncated Conical Shells (Loud Speaker Diaphragms).

In investigating modes of vibration of truncated conical shells of paper, aluminium, and glass, the frequency of a certain resonance group was found to be dependent upon the dimensions only. Table 1 gives some of the data obtained when the cones were driven in a large, highly damped room, by a coil 2.5 cm in radius wound on a short paper tube.

1. AIR COLUMN RESONANCES

| Material and Thickness (cm.)       | Radn (cm.) and Apical Angle | Main Frequency (~) |
|------------------------------------|-----------------------------|--------------------|
| Paper, $2.1 \times 10^{-2}$        | 12.2, 2.5, $90^\circ$       | 900                |
| " "                                | 12.2, 2.5, $60^\circ$       | 650                |
| " "                                | 12.2, 2.5, $30^\circ$       | 350                |
| Aluminium, $8 \times 10^{-2}$      | 19, 2.5, $90^\circ$         | 570                |
| Glass, about $1.65 \times 10^{-1}$ | 12.7, 1.4, $107^\circ$      | 1100               |

The resonance is mainly due to the air column within the cone, the source of vibration being the cone itself. (The air column is stopped by the magnet at the coil end, excepting for leakage between the coil and magnet.) The problem differs, therefore, from that of a simple source (of small magnitude compared with the wave-length), situated somewhere in the air column.

The main frequency is given approximately by the formula

$$f = c/2(l + ka),$$

where  $c$  is velocity of sound in free air,  $l$  is axial length of cone plus part of paper tube,  $a$  is radius of open end, and  $k$  is an end correction factor varying from 0.6 to 0.8. This result is reminiscent of that of Wheatstone, who found (about 1870) that the fundamental of a small angle cone is twice that of a cylinder of equal length. Here the source was a tuning-fork near the mouth, which is different from the present case.

Experiments on the symmetrical modes of conical shells show that they occur at much closer frequency intervals than those of a circular disc.

The most definite results have been obtained with an ordinary glass lamp-shade

2 GLASS CONE, RADII 12.7 CM, 1.4 CM  
 $\psi = 107^\circ$ ,  $t = 1.65$  MM (ABOUT) DRIVING COIL 2.5 CM RADIUS

| Nodal Pattern | Frequency (~) | Rel Output (approx) |
|---------------|---------------|---------------------|
| One circle    | 4500          | 10                  |
| Two circles   | 5700          | 44                  |
| Three circles | 7500          | 19                  |

The greatest output corresponds to two nodal circles, and the three peaks are very sharp indeed. With paper cones the peaks are not clearly defined, especially if the mass of the driving coil is small.<sup>1</sup> In fact, over a band of frequencies the output changes but little. The definition increases with the thickness of the material.

These results indicate that the 900-cycle resonances described in a recent paper<sup>1</sup> are mainly due to the air column, whilst those around 2300 cycles pertain to the symmetrical modes. The relative importance of the air column resonances obviously increases with decrease in the mass of the diaphragm, since the amplitude is greater, for example, for paper they are about 0.5 that at 2300 cycles, whilst for the heavy glass cone they are negligible.

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<sup>1</sup> McLachlan and Sowter, *Phil Mag*, 12, 771, 1931

#### Propagation of Hertzian Waves in Electronic Gas under the Influence of a Magnetic Field

WHEN an electromagnetic wave of frequency  $\nu$  travels through a medium consisting of free electrons ( $e/m = 1.78 \times 10^{-7}$  e.m.u.) under the influence of a

magnetic field  $\vec{H}$  of suitable direction and strength ( $H = 2\pi m\nu/e$ ), an irregularity in the propagation of the wave is predicted from the fact that the electrons, under the influence of the field, are caused to move on closed orbits with the same frequency as that of the incident wave, and therefore they are tuned to resonance and absorb a part of the energy of the wave. To this fact may be attributed the irregularity in the propagation of the wave of 214 metres wave-length ( $\nu = 1.4 \times 10^6$  hertz) travelling in the earth's magnetic field ( $H = 0.5$  gauss). This irregularity has been predicted by Appleton<sup>1</sup> and found by Taylor<sup>2</sup> in experiments made on reception from stations radiating waves of the same power and of a wave-length between 15 metres and 600 metres.

Since very short continuous waves may be obtained in the laboratory by thermionic valves, it is possible to confirm the phenomenon by direct experiment. I have used 18 cm waves, produced by an oscillator of Pierret<sup>3</sup> type. As a receiver I have used a short tuned antenna in which a galena rectifier, connected with a sensitive galvanometer, is inserted. The experimental arrangement allows the wave from the oscillator to pass through the anode filament space of a diode placed inside a coil producing the magnetic field, the filament is arranged along the lines of force. Under the combined influence of the magnetic and the electric field, due to anode potential, the anodic space is filled with almost circular electronic orbits lying in planes perpendicular to the lines of force. Special precautions were taken to lessen the remarkable diffraction phenomena and to prevent the diode itself oscillating in the magnetic field.

Lighting the diode causes a distinct diminution in the galvanometer deflexion due to the arriving wave, when the strength of the magnetic field is about 600 gauss. The effect disappears at values of field strength a little greater or smaller than the above mentioned, which corresponds, to a good approximation, to the value (562.7 gauss) theoretically necessary to give to the electrons, rotating in the orbits inside the diode, the frequency of  $1.6 \times 10^9$  hertz corresponding to a wave-length of 18 cm.

I have found that the observed effect

(a) Is proportional to the number of the absorbing orbits produced inside the diode,

(b) Increases linearly with the energy of the incident wave,

(c) Accompanies the incident vibration, whatever may be the plane in which this vibration is polarised with reference to the electronic orbits inside the diode.

Experiments are being carried on in order to confirm directly some consequences suggested by the theory on propagation of Hertzian waves in an ionised medium under the influence of a magnetic field.

I am indebted to Prof. Q. Majorana for his interest and advice in connexion with this investigation.

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 Dec 31.

<sup>1</sup> E. V. Appleton, *Proc Phys Soc*, 37, 160-230, 1925

<sup>2</sup> A. H. Taylor, *Proc Inst Radio Eng*, 13, 677-685, 1925

<sup>3</sup> E. Pierret, *C R*, 186, 1284, 1601, 1928

#### A Method of High-Frequency Stroboscopy

AN extension of the principle used in the preliminary investigations on the modes of vibration of a quartz crystal, as indicated in a previous note,<sup>1</sup> has enabled the observance of the density changes within the crystal to be carried out stroboscopically.

The apparatus and the general arrangement is as previously described, with the exceptions (a) that two crystals are used, and (b) that a mechanical interrupter is arranged to intercept the light-beam just in front of the image. The two crystals in the present case are practically identical, their frequencies corresponding to Fig. 1 in the previous note, being approximately 88 kc, and 88 kc and 42 c respectively.

By adjusting both crystals in the manner described previously, one in each light-beam, and also by so placing them that they are superimposed optically, it is possible, when both crystals are oscillating, to adjust the speed of the interrupter (to, say, 40 interruptions a second) so that the narrow dark band normally seen changes width cyclically. Similarly, when other modes of vibration are used the periodic variations in density through various parts of the crystal may be readily followed at a convenient speed.

Not only may this method be used successfully for the density changes within the crystal, but it may also be applied to the radiated sound-field, this is effected by the superposition of the two sound-fields in exactly the same manner as the crystals were superimposed above. Again, by correct interruption, it is possible to see the brilliant striations of half-wave spacing progressing at slow speed from the active face of the crystal.

Furthermore, it is not necessary to limit oneself to two crystals exactly similar in dimensions when observing the sound-fields, as a frequency difference of up to 1 kc may be readily corrected by a suitably designed interrupter, thus two very dissimilar crystals with resonant frequencies of 103.6 kc and 104.5 kc respectively have been successfully used as sources of the two sound-fields.

It is clear that the method indicated in the previous note will produce, by means of density variations, the same result as was obtained by Kerr Grant<sup>2</sup> by means of optical rotation, namely, the high-frequency interruption of light. Although the resultant light in this case has not been examined with a rotating mirror, it is obvious from the stroboscopic result obtained that such high-frequency interruption is occurring.

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<sup>1</sup> NATURE, Jan 9, 1932, p. 59

<sup>2</sup> NATURE, Oct 22, 1927, p. 586

### Hyperfine Structure of the Mercury Line $\lambda 4916$ .

IN a recent note,<sup>1</sup> Venkatesachar and Sebaiya have repeated their measurements on the hyperfine structure of the mercury arc line  $\lambda 4916$  and again find a coarse octet structure as before. This contradicts the narrow quintet structure previously reported by me<sup>2</sup> and by Hansen<sup>3</sup>. Recently, two further reports have appeared, namely, that of Murakawa<sup>4</sup> and of Schuler and Keyston<sup>5</sup>. The structures given by the various observers (in  $\text{cm}^{-1} \times 10^{-3}$ ) are shown in the accompanying table, the central component being given the intensity 30 in all cases.

| T.      | H        | M       | SK      | VS       |
|---------|----------|---------|---------|----------|
| 128 (2) | 121 (15) | 125 (3) | 125 (2) | 612 (3)  |
| 62 (3)  | 66 (9)   | 60 (3)  | 66 (3)  | 364 (6)  |
| 0 (30)  | 0 (30)   | 0 (30)  | 0 (30)  | 124 (9)  |
| 55 (4)  | 56 (12)  | 55 (7)  | 56 (5)  | 0 (30)   |
| 98 (1)  | 98 (6)   | 96 (1)  | 99 (1)  | 83 (6)   |
|         |          |         |         | 240 (3)  |
|         |          |         |         | 306 (15) |
|         |          |         |         | 572 (6)  |

The sources used by the different observers are as follows

T.—Tolansky—high frequency electrodeless discharge

H.—Hansen—water-cooled arc (Lummer lamp)

M.—Murakawa—source unspecified

SK.—Schuler and Keyston—hollow cathode discharge

VS.—Venkatesachar and Sebaiya—branched arc

The first four agree extremely well, there being intensity deviations only in Hansen's data.

According to the analysis given by Murakawa and by Schuler and Keyston, only the narrow quintet should be expected. It is very probable that the components 124, 0, 83 of Venkatesachar and Sebaiya are in reality the five components of the other observers, appearing as a triplet when unresolved. It seems quite certain, when the various sources are considered, that the quintet structure is the normal structure of the arc line. The 'branched arc', then, appears to give the normal structure together with five other strong components. If this coarse structure is correct, it can only be due to the source. Such an unusual dependence of fine structure upon source is quite exceptional. Collins<sup>6</sup> found unusual resonance fine structure in  $\lambda 5461$  in mercury, but in this case components were missing, whereas  $\lambda 4916$  appears to give new components in addition to the arc structure. The dependence of the fine structure of  $\lambda 4916$  upon the source employed is worth further investigation.

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<sup>1</sup> Naturwissenschaften, 19, 1041, 1931

<sup>2</sup> Proc Roy Soc, A, 130, 558, 1931

<sup>3</sup> NATURE, 119, 237, 1927

<sup>4</sup> Sci Pap Inst Phys Chem Res, 17, 1, 1931 Z Physik, 73, 366, 1931

<sup>5</sup> Z Physik, 72, 423, 1931

<sup>6</sup> Phys Rev, 32, 753, 1928

### Saxifrage Crosses

DR F. W. SANSOME<sup>1</sup> questions the assertion made by me<sup>2</sup> that *Saxifraga potternensis* arose from a doubling of the chromosome complement at the semi-heterotype divisions in the  $F_1$  plant of the cross *S. rosacea*  $\times$  *S. granulata*, and offers the alternative suggestion that the  $F_1$  plant was wholly or in part tetraploid in its somatic tissue.

Collections of cytological material were made in the summer of 1931 from  $F_1$  generation plants, as well as from certain reciprocal and back-crosses. Unfortunately, time does not permit a detailed study of all this very interesting material available as a result of breeding work at the Potterne Biological Station, but sufficient re-examinations of  $F_1$  plants have been made to confirm the opinion first put forward in 1930.

As originally stated, all pollen mother cells studied had the parental chromosome number, with very irregular divisions and marked lagging of univalents on the way to the poles during the heterotype division. There is no doubt about the presence of a certain proportion of non-reduction, either by cancellation of the meiotic division or by the fusion later of homotype plates. The general proportion of healthy pollen grains was in agreement with the number of non-reduction divisions noted in the same flower, and would be, in my opinion, sufficient to permit of a reasonable seed production.

Dr Sansome's suggested method of origin implies that the behaviour at meiosis and the general fertility (percentage of good pollen and quantity of seed produced) in the flowers of the  $F_1$  generation should be more or less comparable with that of the  $F_2$  plants, as is the case with the examples quoted in his table from the genera *Nicotiana*, *Primula*, and *Solanum*. No evidence to support this contention was found in the material, nor was any part of the plants examined tetraploid in its somatic cells.

In the absence of data regarding the actual seed production of the  $F_1$  plant as compared with the  $F_2$  plant, and of definite evidence showing that all the seed which gave rise to *S. potternensis* came from one (tetraploid) part of the  $F_1$  plant, there does not appear yet to be any good reason why my interpretation should not be feasible.

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<sup>1</sup> NATURE, Jan 10, 1931

<sup>2</sup> J. Genetics, 23, pp. 93-121, 1930

### A New Autotrophic Bacterium which Oxidises Ammonia directly to Nitrate and Decomposes Petroleum.

IN connexion with the studies of the senior writer<sup>1</sup> on living micro-organisms in ancient rocks, an attempt was made to determine whether or not old materials other than rocks harbour living micro-organisms. Among such materials studied was petroleum. An attempt to find cellulose-destroying organisms in petroleum by inoculating the latter into a cellulose medium yielded an organism which apparently has no power to decompose cellulose but has an extraordinary physiology. It was isolated from petroleum derived from a well more than 8700 feet deep, owned by the Standard Oil Company of California.

The organism is a coccus or cocco-bacillus, variable in size and somewhat so in shape. It grows very well under strictly autotrophic conditions in an inorganic salt medium with ammonium sulphate or



potassium nitrate as the source of nitrogen. It oxidises ammonia directly to nitrate without passing it through the intermediate step of nitrite formation as do the group of bacteria known as nitrifying bacteria. The nitrate producing power, moreover, is manifest very quickly under such conditions—much more so than is true of the nitrifying bacteria. It is apparently a facultative aerobe. In addition, it possesses the power of completely decomposing petroleum without apparent gas formation aside from the end-product, gaseous carbon dioxide.

We have noticed in the literature two or three cases in which organisms isolated from soil were described as possessing the power to oxidise ammonia directly to nitrate. These reports have never been confirmed, and the other powers attributed to our organism above have not been indicated in such earlier reports. A full account of our investigation with this remarkable organism will be published elsewhere, together with a comparison of our results with those of Kaserer, Sohngen, and others whose work has a bearing on the subject under discussion.

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L. GREENBERG

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Berkeley, U.S.A., Dec. 23.

<sup>1</sup> *J. Bact.*, vol. 22, No. 3, p. 183, Sept. 1931.

### Periodic Precipitation.

PROF. J. W. MCBAIN has directed attention<sup>1</sup> to the very beautiful experiments carried out by Dr. H. W. Morse, an account of which was published last year in the *Journal of Physical Chemistry*, together with thirty-two remarkable photomicrographs illustrating various types of periodic precipitation in aqueous solution in the entire absence of gels. As Morse points out, it follows that "no gel is necessary for periodic precipitation." He further states that preliminary measurements indicate that ring formation in water follows the same rule as in gels, namely, that the ratio  $\frac{d_3 - d_2}{d_2 - d_1} = k$ , where  $k$  is a

constant ratio of increasing distance between neighbouring rings. The two phenomena thus appear to be due to essentially the same cause.

Morse suggests as an explanation for periodicity of precipitation in aqueous solutions that there is a rapid change at the point where the ring appears, due principally to the diffusion of the reacting substance, resulting first in saturation with the substance of the precipitate, then in a rapid increase in the degree of supersaturation, and finally in 'release' of supersaturation, this release taking place in the absence of nuclei of the solid phase.

In 1922, when studying periodic precipitation of silver chromate in gelatin, we suggested<sup>2</sup> that the distance between successive rings is determined by the difference between the rates of diffusion and of precipitation in the gel; we also showed that protective colloids tend to retard the velocity of such reactions as involve a change of state. Morse's experiments would appear, therefore, to support our view that the main effect of the gel is to retard the 'release' of supersaturation and thus to enhance the relative effect of diffusion, this resulting in an increase in the distance between successive rings, other things being equal, over that in the absence of the gel.

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<sup>1</sup> NATURE, 128, 1042, Dec. 19, 1931.

<sup>2</sup> *J. Chem. Soc.*, 121, 472, 1922.

### Photoreduction of Carbonic Acid, Bicarbonates, and Carbonates to Formaldehyde.

IN these laboratories we have been carrying on experiments on photosynthesis in tropical sunlight for a number of years<sup>1</sup>. We have been able to obtain formaldehyde by the exposure of solutions of carbonic acid and bicarbonates to tropical sunlight in presence of various inorganic and organic photocatalysts.

Now we have been able to reduce carbonic acid, carbonates, and bicarbonates to formaldehyde by means of metallic magnesium and zinc. The yield of formaldehyde in light is considerably greater than that in the dark. Contrary to the observations of Fenton,<sup>2</sup> we could not detect any formic acid either in sunlight or in the dark. It should be pointed out here that Fenton carried on his experiments only in the dark, and obtained formic acid as the main product by the action of an amalgamated magnesium rod on carbonic acid. The chief importance of these experiments consists in the fact that the yield of formaldehyde obtained in our photoreduction experiments is much greater than hitherto obtained by any previous worker. Moreover, we have been able to increase the yield further by the addition of photosensitisers like zinc oxide.

We have found that the photoreduction of these substances can also be effected by ferrous carbonate. These experiments lend considerable support to the view previously announced by us that chlorophyll, besides being an optical sensitiser, also acts as a reducing agent.

From 100 c.c. of a 10 per cent solution of potassium bicarbonate with 1 gram of powdered magnesium in presence of zinc oxide after an exposure of five and a half hours to sunlight, the yield of formaldehyde is 0.0045 gm. No reducing sugar could be detected in these photoreduction experiments with powdered magnesium.

Further work in this direction is in progress.

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Dec. 21

<sup>1</sup> Dhar and Sanyal, *J. Phys. Chem.*, 29, 926, 1925; Gopala Rao and Dhar, *J. Phys. Chem.*, 35, 1418, 1931; *ibid.*, 1423, Dhar, Rao, and Ram, *Trans. Farad. Soc.*, vol. 27, 554, 1931.

<sup>2</sup> Fenton, *J. Chem. Soc.*, 91, 687, 1907.

### Helmholtz or Kelvin Cloud Waves.

IT is of some historical interest to notice that the habitual use of the phrase 'Helmholtz Waves' to describe parallel rolls of cloud produced in the transverse direction by a wind in an upper region blowing over stationary air below is only partly justified, and many students of hydrodynamics are unaware of Kelvin's work in this connexion. It is true that Helmholtz in 1889<sup>1</sup> worked out the theory of these waves and applied it to clouds. But, as he pointed out in a footnote, the general theory of such waves between two media in relative motion had been given by Kelvin in 1871<sup>2</sup>, so while the meteorological application was due to Helmholtz, it was Kelvin who provided the essential hydrodynamical explanation.

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<sup>1</sup> *Sitz. Abh. Wiss. z. Berlin*, 761-780, or *Wiss. Abh.*, 3, pp. 309-332.

<sup>2</sup> *Phil. Mag.*, 42, pp. 368-370, "Math. and Phys. Papers", 4, pp. 76-79.

## Research Items.

**Ethnic Pathology**—Some interesting personal observations are recorded by Prof V Suk in the course of a discussion of possible lines of research in ethnic pathology in *Pub* No 141 of the Faculty of Science, of the Masaryk University, Brno. In dealing with the incidence of tuberculosis among the Eskimo of the north coast of Labrador, he states that in examining about a hundred children, pure and mixed, the cutaneous tuberculin test gave 9.8 per cent positive reactions among Eskimo children of pure blood (51 cases) and 56.2 per cent among mixed breeds (32 cases), that is, an overwhelming preponderance of infection among those who live in an Eskimo climate on European food such as tinned meat, tinned margarine and bad flour, as opposed to the Eskimo diet of raw seal blood, meat, and entrails. Yet on the other hand, tuberculosis is very fatal to the Eskimos when once they are attacked. They succumb in a few weeks. Among them it is a new disease, whereas among Europeans it is of long standing, progress of the disease is normally slow, and evidently partial immunity has been established. Prof Suk has also some interesting observations to make on the subject of cretinism. He finds that in cretinism characteristic racial features may be blurred beyond recognition and 'cosmopolitan' cretinous features established. Thus one case in Carpathian Ruthenia he found, to his surprise, was not a Ruthenian but a Jewess, while in other cases in which several cretins occurred in one family, there were different degrees of development in which particular racial features were blurred to a varied extent. In discussing other lines of investigation, Prof Suk points out the need for inquiry not only among primitive peoples but also among the civilised. Relatively little precise and well documented evidence is available for the incidence of disease in nordic, alpine, and Mediterranean races.

**The Flight-speed of British Birds**—Further data supplementing the records by T H Harrison (*NATURE*, Oct 3, 1931, p 586) have been published (*Brit Birds*, Jan). The records were made by B B Roberts from a motor car with reliable speedometers, when there was no appreciable wind and when at least sixty yards and usually more than a hundred yards had been travelled parallel to the birds' course. The fastest of the times was 51 miles per hour recorded for a wood-pigeon, chased up from its average of 47 m p h, which was exactly the speed of a red grouse, the slowest, a striking record, the 15 m p h of a common tern. On the whole, wherever they can be compared, the readings of the two independent observers are very similar. According to one, the rook ranges from 24 to 35 m p h, according to the other, 27 to 35 m p h, the starling, 25 to 30.5 and 28 to 41, the chaffinch, 25 to 29 and 27 to 35, or of the more rapid fliers, the wood-pigeon, 27 to 51 and 23 to 47. The one migration record of this series, that of a flock of lapwings, indicates, as the former series suggested, that migration flight is distinctly more rapid than normal flight, for the lapwing's average was only 28.33 m p h, whereas the flock travelled at 41 m p h. The result of the records as a whole is to confirm the impression that the earlier notions about the speed of bird flight were much exaggerated.

**Regulation of the Blood in Fishes**—In fresh water a fish, because of the salt content of its blood, is osmotically superior to its environment, so that it excretes a solution more dilute than its blood—hypotonic excretion. In salt water the condition is reversed and

the fish must get rid of a solution more concentrated than its blood—hypertonic excretion (Homer W Smith, *Copeia*, Dec 1931, p 147). The vertebrate kidney at any stage lower than mammals is incapable of excreting a hypertonic urine, and, amongst fishes, teleosts and elasmobranchs have solved the problem in two different ways. The teleost 'drinks' sea water, and absorbs the water and most of the salts from the gut. The salts it excretes for the most part extrarenally (by the gills), thus leaving water osmotically free for the formation of urine in compliance with the osmotic limitations of its kidneys. The elasmobranch does not require to drink sea water, since it conserves urea by reabsorbing it from the urine, so that a natural uremia results, the urea concentration of the blood rising to as much as 2.5 per cent. The raising of the osmotic pressure of the blood above that of sea water means that water is directly absorbed, probably through the gill membranes, while salts are partially or wholly excluded. So in the sea the teleost retains for itself the relative balance with its environment which is characteristic of fish life in fresh waters.

**Composition of the Body Fluid of Animals**—C F A Pantin has discussed (*Biol Rev*, vol 6, pp 459-481, 1931) not only the origin of the body fluids in animals, then approximate similarity in composition and relation to sea water, but also the mechanism whereby in some organisms the composition of the body fluid may be maintained, though quite different from that of the external solution. It is shown that there are all gradations, from the simplest case, in which the body fluid closely resembles the external solution (sea water) both with regard to total osmotic concentration and to the relative proportion of the salts, to the more complex, in which, not only does the composition deviate from that of sea water (particularly in a tendency to increased potassium and decreased magnesium and sulphate concentrations), but also the total osmotic concentration no longer equals that of the surrounding medium and an increased osmotic independence of the environment is obtained. Both the osmotic gradients and the ionic concentration gradients are discussed and interpreted as actively maintained by a steady state in which work is done, and are not regarded as determined by equilibrium conditions.

**Larvæ of Leaf-mining Beetles**—In the course of his studies "On the Structure of Larvæ of Hispine Beetles" (*Proc Zool Soc*, London, part 3, 1931, pp 1137-1162), Mr S Maulik directs attention to the fact that the conception of an adult insect as being the end-stage or completion of a species is pure presumption. He looks upon the adult as but one stage in a continuous cycle. "While", he says, "the adult stage is being formed, the next stage is also taking form, and so the observed sequence of events goes on." The view that the "adult stage is the end result to which the organism is attaining" has directed attention away from the study of larval characters. Nevertheless, he points out that the larvæ described in this paper are generally more adaptable, and therefore their characters more plastic, so that in doubtful cases of relationship more reliance should be placed on adult characters. This is the generally accepted view in other groups of insects, but Mr Maulik thinks it should not be accepted in any group until it has been proved in that group also. Altogether seven species of larvæ are described in detail, all of them beautifully figured by Mr Terzi,

in two of them the complete life history is worked out. The special adaptation of the spiracular organs of these larvæ to the leaf-mining habit is particularly interesting.

**Stone Cells of Pear Fruits**—Stone cells were described by Nehemiah Grew so early as 1682, but their practical significance from the point of view of fruit quality has only just been studied by J. W. Crist and L. P. Batjer (*Tech. Bull.* No. 113, Michigan State College Agricultural Experiment Station "The Stone Cells of Pear Fruits, especially the Kieffer Pear", pp. 55, 1931). The authors have tried the effect of various cultural treatments, propagation influences, size and vigour of tree, and different times and methods of ripening on the number of stone cells present in the pear fruit. They have been unable to reduce the number of stone cells by any such treatments, and conclude that improvement of the Kieffer pear must be through genetics. They publish some striking photographs showing varietal differences in stone cell content, and have made chemical studies of the fruits. There is a difference in the seasonal hydrogen ion concentration of the tissue of Kieffer and of Bartlett pears which seems to bear some relation to the stone cell content. The former is relatively more acid than the latter in May, but towards the end of June the position is reversed. A similar reversal in the number of stone cells is also observed, Bartlett having more than Kieffer in May and less in June.

**Recent Scottish Earthquakes**—Dr. G. W. Tyrrell has published a very valuable account of four earthquakes felt in Scotland in 1925 and 1927 (*Trans. Glasgow Geol. Soc.*, vol. 19, pp. 1-41, 1931). The Oban earthquake of Dec. 23, 1925, is of great interest from its probable connexion with the Great Glen fault, along which most of the strongest earthquakes in the country originate. This shock was of intensity 6 (Rossi-Forel scale). The boundary of the disturbed area cannot be traced with exactness. Excluding isolated records, it appears to have contained about four thousand square miles, though it may have been four times as much. The most interesting of the other earthquakes was the North Sea earthquake of Jan. 24, 1927, one of the strongest ever felt in Scotland. The disturbed area included practically the whole of that country with the exception of the Western Islands. Within a small district near Peterhead the intensity was 7. The shock was also felt at Warkworth in Northumberland, and over a large district in southern Norway. The epicentre, as determined from seismographic records by Dr. N. H. Kolderup, lay in lat.  $59^{\circ}$  N, long.  $5^{\circ}$  E, that is, under the North Sea not far from the coast of Norway, between Haugesund and Stavanger. The focus is thus asymmetrical with reference to the isoseismal lines, and this raises the question whether there may not have been a second focus nearer the Scottish coast, for the shock in Great Britain was distinctly double.

**Oilfields of Zante**—Zante is the southernmost of the Ionian Islands, and its association with petroleum goes back a long way in history. Both Pliny and Herodotus have referred in their writings to the 'pitch' of the island, and local tradition assigns the ancient well of Herodotus to this place. Occurrences of oil in the island have been described by Redwood, and Dr. A. Wade gave the Institution of Petroleum Technologists an interesting account of its geology and ancient oilfields on Dec. 8 last. The island may broadly be regarded as a remnant of a rectangular block of resistant Cretaceous Eocene limestone orientated north-west-south-east, tilted slightly to the north-east, overlain by Miocene and Pliocene sediments.

The Miocene deposits include gypsiferous deposits with associated clays and bituminous marls, there are also nummulitic limestones and bituminous limestones of Eocene age. The author leans to the view that the oil originated in the Miocene series in which it occurs, but he also points out that there may be, by analogy with the bituminous limestones of Cretaceous-Eocene age in the Grecian archipelago, deeper and totally independent oil-bearing strata in the underlying rocks of that age in the island. Actually the so-called 'pitch' of Zante is a very heavy crude oil, and Herodotus's 'pitch' well at Keri Marsh was evidently a seepage of this material. The well is a brackish water spring carrying oil and inflammable gas, stimulated by the latter, several unsuccessful attempts have in the past been made to obtain the oil in commercial quantity, failure being due, according to the author, to lack of knowledge and inexperience on the part of the early operators. Results of physical examinations of two samples indicate that the oil is of asphaltic base, specific gravity 1.010-1.0046, about 1 per cent petrol, 14 per cent kerosene, 30-40 per cent lubricating oil, and 40-50 per cent asphalt, there is apparently some 6 per cent of sulphur.

**Aerial Phototriangulation**—One of the difficulties in measuring the arc of meridian which passes through the Balkan peninsula and eastern Africa is to bridge the gap afforded by the Mediterranean. The chief problem lies between Crete and Egypt, a distance of about two hundred miles at least. The heights on the opposite sites, despite the considerable altitudes in Crete, are not sufficiently great to allow sights to be taken across the sea. An ingenious method is suggested by Prof. D. Lampadariou (*C. R. Acad. Athènes*, April 6, 1931). He suggests the use of three known points in Crete and another three in Africa. From these points brilliant lights would be shown and recorded simultaneously on one plate exposed by an aeroplane roughly midway between the two coasts. This would enable six horizontal angles to be fixed from the developed plate. In fact, the aeroplane would thus serve as an intermediate station between Crete and Africa. Prof. Lampadariou explains in his paper the apparatus required and the necessary precautions to be taken.

**Measurement of High Temperatures**—The accuracy and reproducibility of the high temperature scales in use in various laboratories appear very clearly in an account of an intercomparison of scales given by Dr. W. E. Forsythe, of the Lamp Development Laboratory of the American General Electric Co., in the second September issue of the *Physical Review*. A number of tungsten lamps were carefully aged and calibrated at Nela Park, and were then sent to the Physikalisches-Technische Reichsanstalt in Berlin, Philips' lamp works in Eindhoven, the Laboratoire Central in Paris, and the Osram works in Berlin. In each place the temperatures of the lamps were measured for specified currents with a disappearing filament optical pyrometer, using red glass as the monochromatic screen. After making certain necessary alterations to the temperatures recorded directly, excellent agreement was found, the maximum difference being only a few degrees for any part of the range between  $1400^{\circ}$  K and  $2700^{\circ}$  K. Similar concordance was found with lamps made at Berlin and at Eindhoven. A typical case is that of the lamp F-117-C, made at Nela Park, which when taking a current of 16 amp was estimated to give a temperature of  $2041^{\circ}$  at the place of origin in September 1924,  $2039^{\circ}$  when tested at the Berlin Osram works in June 1925, and  $2043^{\circ}$  when again returned to Nela Park in

January 1926 The actual discrepancies, small as they are, are believed to be due partly to a lack of constancy of the lamps.

**Absolute Measurement of Voltage**—In connexion with astronomy, electrostatics, hydrodynamics, and mathematics, the properties of the ellipsoid have been studied very assiduously for the last two hundred years Examination questions on them must have been set hundreds of thousands of times It is interesting, therefore, to learn from Prof W M Thornton and W G Thompson's paper to the Institution of Electrical Engineers on Jan 21 that these properties are utilised in their new method of measuring voltages up to 200,000 and of finding the ratio of the electromagnetic to the electrostatic unit of charge At present the most practical method of measuring very high voltages is to find the maximum sparking length at which discharge takes place at this voltage between spherical electrodes Knowing the radii of the electrodes, the temperature, and the atmospheric pressure, the voltage can then be computed or found from tables In the authors' method, a small metallic ellipsoid is suspended by an insulating fibre between vertical circular pole plates When these plates are electrified by the given voltage, its value can be deduced either by a deflexion or an oscillation method The values found for the voltage in this way agree very closely with the values found by sphere-gap methods A drawback to the latter method is that several observations have to be made and a mean taken The accuracy claimed by either

method is 0.3 per cent The authors also made an experiment with the ellipsoid method to measure the ratio of the units, which they give as  $2.9996 \times 10^{10}$ . The mean of the best previous methods is given by Abraham as  $3.0001 \times 10^{10}$  and by Sir Frank Smith as  $2.998 \times 10^{10}$  In making the determination, they assume the values found for the voltages by the spark gap methods

**Temperature of Molecules in a Discharge Tube**—A recent paper by C W W Read (*Proc Roy Soc*, Jan) contains an account of an investigation of the distribution of intensity in some bands ( $\lambda 6100$ — $\lambda 6500$ ) of the molecular spectrum of helium In addition to being an important contribution to the data of band spectra, this is also of interest from the fact that it yields a measure of the temperature of the particular group of molecules involved The intensities were found by the now well-established method of photographic spectrophotometry, with the aid of the new Cambridge form of densitometer, and were shown to conform to theory if the populations of the various energy levels were controlled by a Boltzmann factor, the temperature equivalent of which was  $785^\circ$  abs This is in accord with temperatures of the helium molecules found from the width of the lines in the spectrum, and is, as might be expected, intermediate between the probable temperature of the bulk of the gas in the tube and the electron temperatures which have been found in other discharge tubes by Langmuir's probe method, although it is much nearer to the former

### Astronomical Topics.

**Parallax of Eros**—Dr H Spencer Jones has published a paper on methods of reduction of Eros observations (*Mon Not Roy Ast Soc*, Nov) He notes that to obtain the necessary accuracy the second order terms in differential refraction must be applied, also if there are several images of the planet on a plate, the parallax factors must be computed separately for each image Also, since the mass of the moon is to be found as well as the solar parallax, all plates should be measured both in Right Ascension and Declination He also gives the formulæ for aberration, and asks that these should be applied in the manner stated, for the sake of uniformity He also asks that observers should note which of the secondary stars on the list have been used in their measures, stars that have not been used anywhere need not be observed further, which will save time

**Selenographical Tables and Co-ordinates**—Prof T Banachiewicz, director of the Cracow Observatory, has published these tables and co-ordinates as *Cracow Reprint No 2* He notes that there is now a great increase in the number of occultations of stars by the moon that are observed this is in response to a request from Prof E W Brown, the accuracy of the observations is increased by the distribution of wireless time-signals The present work directs attention to an improvement that can be made in the reduction of the observations, by taking into account the irregularities on the moon's surface Many points on it are above the mean level by a second of arc, others are as much below this level

The tables in this little book give the means of calculating the selenographical co-ordinates of the point on the moon where the occultation takes place Studies of the contours of the moon in different librations have been made, and give some idea of the height of the particular point of the limb

The method of reduction advocated by the author

is according to the Cracovian system, which he introduced some years ago, it is an abridged method of indicating sums of products, analogous to the determinant notation It is explained in the introduction

The tables are based on Brown's lunar tables, Newcomb's formula for the obliquity of the ecliptic, and Hayn's value of the inclination of the moon's equator, which is  $1^\circ 32' 6''$

**A New Canon of Ancient Solar Eclipses**—An important work by R Hiller and P V Neugebauer has been published as an *Erganzungshefte* (Band 8, No 4) to *Astr Nach* (6 gold marks) It is a special canon of eclipses visible in western Asia and in Egypt between 4200 B.C. and 900 B.C. There is an overlap of three centuries with Oppolzer's canon, this was advisable, since improved determinations of the secular accelerations, both in longitude and in other elements, have been made since that canon was published, special acknowledgment is made to the late C Schoch for his useful contributions to the study of the moon's motions There are three separate tables, the most important one gives the elements of 1034 eclipses, also the magnitudes and times of greatest phase at six selected stations Assur (near Nineveh), Babylon, U<sub>1</sub>, Boghaskoi (in Asia Minor), Memphis, and Thebes The second table gives more approximate details of 440 smaller eclipses. The third gives the dates of 350 small eclipses that were not examined in great detail Finally there is a series of maps, one for each period of fifty years, covering the region  $23^\circ$  to  $52^\circ$  east longitude, and  $20^\circ$  to  $45^\circ$  north latitude, these show the central lines of all total and annular eclipses that crossed the region The eclipse of -1062 July 31 is given as total at Ur, magnitude 11.2 digits at Babylon It would seem that a similar canon for China would be useful several eclipse records have come down to us, notably the famous one of Ho and Hi The authors promise a canon of lunar eclipses in the near future

## Progress in Gas and Electric Welding.

THE art of welding iron has been practised for thousands of years, and specimens of ancient welded work, such as chains, are to be found in many museums. Such work was, of necessity, done in the smithy, with a fire, anvil, and hammer. To-day, thanks to the use of gas and electricity, welding can be done wherever it is required, and even bridges, buildings, and ships can be welded instead of riveted. The progress in the art has indeed been remarkable, and only last March the American Society for Testing Materials had a symposium on welding.

In Great Britain the subject is the special study of the Institution of Welding Engineers, at a meeting of which, held at Birmingham on Nov 13, a paper was read on "Boilerworks' Practice", by Messrs E W Thompson and A Jeavons. The flues and furnaces of Lancashire and Cornish boilers were among the first parts to be welded and much work of a similar nature is now done by the aid of water-gas welding machines. An interesting development on the Continent and in the United States is the use of welded drums for water-tube boilers. Such drums cannot, at present, be used in Great Britain owing to the regulations of the insurance companies. The cost of a riveted drum may be £40-£50 a ton, a forged drum £60-£150 a ton according to size, while a welded drum might cost less than £40 a ton. If electric welding is used for pressure vessels a special X-ray radiograph machine is desirable, so that any slag inclusions, gas spots, or incomplete penetration can be detected.

Like so many other industries, that of electric welding traces its history back to Faraday's discoveries, and in the first number of *Electric Welding*, the new house journal of Messrs. The Quasi-Arc Company Limited, is an article on the Faraday Centenary by Mr H M Sayers. Much of the issue, however, is devoted to the use of electric welding

for ships. Descriptions are given of the electrically welded lighter *AC 1320*, built for the Inland Waterways Section of the Royal Engineers in 1918, the *Fullagar*, now the *Shean*, the first completely welded sea-going ship, and two partly welded Japanese vessels. The *Fullagar* was built by Messrs Cammell Laird and Co. in 1920. During her service she has been aground several times, but is still in good condition. She is motor driven and is now engaged in the cement trade in British Columbia.

Another aspect of the subject is presented by the pamphlet "Welding of Structures", by Mr V A Prince, published by the Association of Engineering and Shipbuilding Draughtsmen. Welding, says Mr. Prince, ranks eighth on the list of industries of the United States. As usual, when new processes are applied to production work, it is difficult for the draughtsman to obtain trustworthy data. Mr. Prince's pamphlet contains notes on the methods of electric welding, the plant required, the training of welders, types of welds, and on factors of safety. He then gives designs for a crane girder, a roof truss, and a welded stanchion base. Tests made by the United States Bureau of Standards show that welded stanchion bases are practically as strong as the heaviest types of riveted bases. Welded work will often show a considerable saving in weight and cost over riveted work. The various gas welding methods are water-gas, oxy-acetylene, oxy-coal gas, oxy-hydrogen, and a combined gas and electrical method known as the atomic hydrogen process.

Much research is being carried out in Great Britain, America, Germany, Switzerland, and elsewhere, and methods are becoming standardised and rules formulated. One of the great advantages of using welding for buildings being erected in cities is the absence of noise, such as accompanies riveting.

## Lecture Experiments on the Migration of Ions and the Passivity of Iron.

THE following details of demonstrations successfully made throughout the recent Faraday Exhibition at the Albert Hall may be of use to those who wish to show the migration of ions and the periodic passivity of iron on the lecture table.

## MIGRATION OF IONS

The migration of ions under the influence of an electric current is generally demonstrated by passing a current through an agar-agar gel having in it an electrolyte with a coloured ion, such as copper sulphate, and contained in a glass tube bent into the form of a U. The drawback of this method is that, in order to obtain a good colour, a considerable quantity of electrolyte is necessary, and this increases the conductivity of the gel to such an extent that when more than a small voltage is applied the current produces sufficient heat to melt or in some cases even to boil the gel. Now, as the rate of migration of the ions is proportional to the potential gradient, this small voltage will cause only a slow movement of the coloured boundary, and it is generally found that at least an hour is necessary for any change in position to be observed.

To overcome this difficulty and to make the demonstration more suitable for a lecture experiment, the conditions must be somewhat modified. The electrolyte used is a very small quantity of sodium sulphate, and to render the moving boundary visible an acid alkali indicator, bromo-cresol purple, is also added.

The U-tube is made in the form of a lantern slide, so that the image of the moving boundary can be projected on to a screen. The slide is made by cutting a lantern plate along the dotted lines as shown in Fig 1 and removing the shaded portions. This plate is then cemented between two other plates, using Canada balsam or Coates's cement, thus forming a U-tube in which each limb is  $\frac{1}{2}$  in wide and the limbs are  $\frac{1}{2}$  in apart. The thickness of the U-tube is, of course, the thickness of the glass plate, about  $\frac{1}{20}$  in. It is advantageous to cement another plate to one side of the slide, inserting two narrow strips of glass between this plate and the slide. This provides an air space between the actual slide and the lamp of the lantern, thus reducing the heating effect from this source.

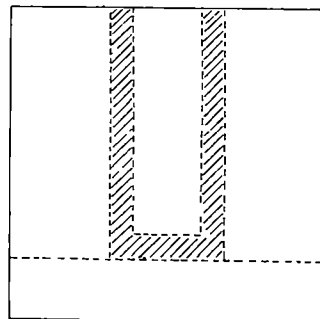


FIG 1

The U-tube is nearly filled with the following solution. Water 100 ml, agar-agar 0.8-1.0 gm., sodium sulphate 0.1 gm. approximately, and sufficient bromo-cresol purple solution to give a good red colour.

When the gel has set, a few drops of very dilute sodium sulphate solution are placed on top of it in each limb and a potential of 200 volts d c is applied across the U-tube, connexion being made by means of platinum wires dipping into the sodium sulphate solution. A purple colour will then move down one limb and a yellow colour down the other, and this movement can be readily observed on the screen, especially if the screen has horizontal lines ruled across it. When the images of the moving boundaries have moved out of the field of view, the current can be reversed so that a yellow colour will move down one limb, obliterating the purple, while the yellow in the other limb will be obliterated by purple.

J. L. BUCHAN

#### PERIODIC PASSIVITY OF IRON

A convenient and effective method for the demonstration of the periodic electrochemical passivity of iron is shown diagrammatically in Fig. 2. *B* is a two-

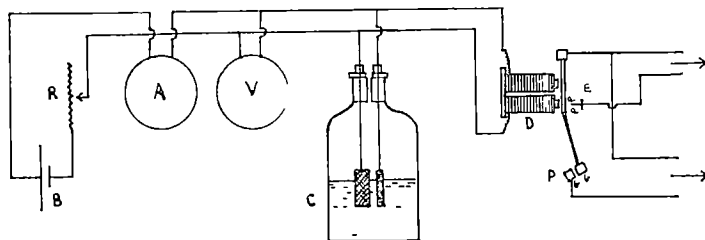


FIG. 2

volt accumulator, *A* an ammeter reading up to 3 amp, *V* a voltmeter reading up to 3 volts, *R* a variable resistance of 16 ohms, *D* an electro-magnetic relay having two sets of contacts, *a, a'* and *b, b'*, such that one of two circuits is completed according to the position of the moving arm. The coils of the relay take approximately 0.3 amp. *C*, the cell, is a 6-oz. bottle fitted with an ebonite top carrying two brass rods and having two vent holes. A platinum gauze is used for

the cathode and an iron plate ( $1\frac{1}{2}$  in.  $\times$   $\frac{1}{2}$  in.  $\times$   $\frac{1}{8}$  in.) for the anode, these being attached to the brass rods with set screws. 85 ml. of sulphuric acid (35 ml. conc.  $\text{H}_2\text{SO}_4$  to 100 ml. water) are placed in the bottle, the anode is then half immersed. The entire cell is maintained at a temperature of  $45^\circ\text{--}50^\circ\text{C}$ . in a water bath.

Periodicity may be started as follows:

The iron anode is dipped in nitric acid (1/2) and allowed to dissolve freely for 10 seconds. It is then removed from the acid, washed, dried, and attached to its appropriate brass rod. The circuit having been completed, the resistance is adjusted to a point when on immersion of the electrodes in the sulphuric acid the current attains a value of 2.2 amp. This is obtained as soon as the acid has overcome the passive film due to the treatment with nitric acid. Thereupon the electrodes are removed from the warm sulphuric acid and immersed in cold saturated solution of ferrous sulphate rendered decidedly acid with sulphuric acid with the current still running, the passive condition now appears. This state is maintained for 1 or 2 minutes, and finally the electrodes are returned to the warm cell. Periodicity will begin and, under the existing conditions, will be maintained until the anode is dissolved.

An adjusting screw *E* attached to the moving arm of the relay by a spring is provided to overcome the magnetic effect produced by the coils when the anode is in the active condition, that is to say, when the amperage is 2.2 and the voltage 0.7. Further, the contact pillar *P* must be so placed that when the amperage drops to 0.3 and the voltage rises to 1.8 (the passive state) the moving arm does not touch the magnets.

In either of the conditions, passivity or activity, one of the relay circuits is completed, whereby it is possible to light up coloured lamps in an alternating manner.

J. G. N. GASKIN

#### Madras Fisheries \*

IN the Administrative Report of the Madras Fisheries Department for the year ending June 30, 1930, the director, Dr. Sundara Raj, records a general improvement in almost every quarter, especially with regard to research work, in spite of the fact that the fishing season on the west coast was exceptionally bad. The Department has now at its disposal the full-sized steam trawler *Lady Goschen*, which has been remodelled and equipped with a laboratory and a whole-time biologist for research on board, and two well-furnished biological stations on shore at Calicut and Krusadai Island.

The chief aim and immediate work in connexion with the trawler is exploratory, as at present practically nothing is known of the contents and character of the seas outside the ten-mile limit. A survey will be made of the deeper water fishing grounds and the determination of the kinds and quantities of the marketable fish available at different seasons and depths together with investigations into the invertebrates, including plankton. Such research naturally involves the use of the best-known methods of capture, and drift and seine nets were on order with a motor boat for working the Danish seine net. At first the systematic survey will be limited to the

offshore belt to 100 fathoms, up to which the local fishermen with slightly improved boats and nets may be persuaded to extend their operations. The systematic survey of the deep-sea fishing grounds by the *Lady Goschen* began in 1927. During the period between Oct. 31, 1927, and March 10, 1928, she explored the extensive trawling ground within the 100-fathom line which lies to the west, south, and east of Cape Comorin, known as the Cape Comorin Bank. Details of the hauls are given in three appendices to Report No. 3, including the most important fishes and invertebrates, and three charts of the area investigated.

Researches on the Madras oyster show that it flourishes in low salinities and that the freshets in rivers, instead of damaging oyster beds as was formerly supposed, apparently provide the most favourable conditions for spawning and development of the local oyster. A field study of the extensive natural beds at Gokulapalli showed three zones, the first, which is dry for part of the summer except for a few hours during high tide, and on which are only small and yearling oysters and where much spat falls, the second, washed frequently by daily tides and exposed for much less time, where only small oysters grow as their feeding hours are limited, the size increasing with the depth, but where a good deal of spat also falls, lastly, a third zone well below the low-tide level where the oysters are large and the spat scarcely settles at all. It is

\* Madras Fisheries Department Administrative Report for the Year 1929-30 by Dr. B. Sundara Raj, Director of Fisheries. Report No. 1 of 1931. *Madras Fisheries Bulletin*, Vol. 25, 1931. Report on a Systematic Survey of Deep-sea Fishing Grounds by S. T. *Lady Goschen*, 1927-28. Report No. 3 of 1929, *Madras Fisheries Bulletin*, Vol. 23, 1931.



suggested that the spat from the first zone should be collected and transferred to the second zone in spring and finally to the third zone in summer, and that the oysters should be collected and marketed from zone three

Experiments in deep-water tank fishing at Mopad shows that there is an increase in size in the fish. The tank had been stocked with fingerlings of local carp, including catla, which is the quickest growing and attains a large size. Catla are probably bottom dwellers as they are only caught with the Ennur nets and cast nets which descend to the bottom. Investigations into the growth of the catla show

that fish 4-9 in long may grow to 13-17 in in four months and that they attain a length of 13-14 in in a year and 23 in in two years, weighing 6 lb after the first year and 15 lb after two years. Thus it is very suitable for rural pond culture. Several pieces of water have been stocked with these and other fish.

Part of the Report relates to various problems in marine, estuarine, and inland fisheries, including scientific and technical research, administration, pearl and chank fisheries, socio-economic work and publications. Part 2 relates to finance, part 3 to the staff. Appendices deal with statistics.

## The University of Edinburgh

### EXTENSION OF DEPARTMENTS OF GEOLOGY AND ENGINEERING

ON Jan. 28, the Prime Minister opened two recently completed extensions of the University of Edinburgh—the Grant Institute of Geology and the Sanderson Laboratories of Engineering—erected on the West Mains site, on the southern edge of the city, adjacent to the Departments of Chemistry, Zoology, and Animal Genetics, all of which are post-War extensions. The new Institute of Geology has been provided by Sir Alexander Grant, who gave £50,000 for this purpose, the new Engineering Laboratories have been built from a bequest of £50,000 by Mr James Sanderson of Galashiels and a gift of £2000 by the Carnegie Trust. The chancellor of the University, Sir James M. Barrie, presided at each of the opening ceremonies, and his brief introductory remarks were characterised by his usual charm and humour. Among those present at the ceremony in the Geology Department were the Lord Provost of Edinburgh, Sir Thomas Holland, the Right Hon. Sir A. Sinclair (Secretary of State for Scotland), Lord Elgin, Sir Alexander and Lady Grant, and a number of well-known geologists, including Sir John Flett, Profs. W. W. Watts, W. T. Gordon, O. T. Jones, E. B. Bailey, and P. G. H. Boswell.

In opening the building, the Prime Minister spoke in a manner which revealed his own interest in geology and his pleasure in recalling his study of "Vestiges of Creation", and of Hugh Miller's "Footprints of the Creator" and the "Testimony of the Rocks", and of "the wonderful Saturdays spent in trying to discover in the Tynet Burn, where Hugh Miller and others worked, those nodules which split to reveal their secrets. That extraordinarily characteristically Scottish controversy on the six days of creation has contributed more than any other controversy to stimulating the general intellectual curiosity of the generation to which I belong and of the generation immediately preceding. Those who enter these walls now will perhaps not find in the study of geology such an invigorating background."

"I am not at all sure", Mr MacDonald continued, "that scientific investigation can be adequately carried out, can receive the stimulus required for its continued progress, unless those who are experts manage somehow or other to keep in contact with the young men of the street and the market-place. In a conversation I had not long ago with Einstein, I accused him of destroying elementary science. He defended himself with the vigour you can imagine. I laid down the proposition that scientific knowledge must not be so far ahead of common interest that it becomes isolated from the ordinary intellectual life and curiosity of its generation. That is a problem for you to solve. Surely, dull must be the human mind when it ceases to take an interest in the world, its structure, its evolution, the forces that have made

it and that may in time destroy it. When we cease to take an interest in that when we cease to feel the inspiration of that which is on the border-line of the known and the unknown, the knowable and the unknowable, then I think everything that characterises human intelligence will have gone out of it."

Prof. T. J. Jehu expressed the thanks of the University to the Prime Minister and to Sir Alexander Grant.

A similarly distinguished gathering which assembled in the Engineering Department included also representatives of the Sanderson Trustees, Sir Murdoch MacDonald, representing the Institution of Civil Engineers, and Prof. J. D. Cormack, the University of Glasgow. The Prime Minister, in opening the Department, referred to the evolution in the meaning of the term engineering—once purely a military process but now become mainly a civil process—a point which he will carry with him to Geneva. He observed how the University of Edinburgh is equipping itself for the future—a future of skill, of adaptation of the powers of scientific discovery to commercial operations upon the success of which and the international free flow of which depend the well-being and the wealth of every individual nation on the face of the earth. "You are not going to establish", he said, "the greatness of a State or the greatness of a people on material achievements alone. The more we advance in our engineering achievements the more must we be careful of the soul and the spirit of things. Edinburgh turned into a factory only would not be the Edinburgh that inspired us all and made us proud that it is our capital city. Nor must the city be a dead museum. The ghosts of the past must never be banished from the streets of Edinburgh. But while preserving that, while planning our Edinburgh that these ghosts are not laid by the efficient brutalities of up-to-date materialism, we must see that our Edinburgh in its institutions, in its work, above all in its University, must equip its young men and its young women with a full knowledge of the past and yet able and efficient to make future contributions to the glory and greatness of our city. Brains, knowledge, and capacity are to be put at the disposal of what I am convinced is a developing nation. In these days the development of a nation and its prosperity depend very largely on the way that it uses mechanical power. The adaptation of driving power to new forms of material, the capacity to apply scientific discovery, are the lines upon which this nation is going to move out of the past into the future. All things pass away, everything becomes new, and that text cannot be better applied to anything than to the evolution of power to transport."

Sir Thomas Hudson Beare offered to the Prime Minister and to the Sanderson Trustees the thanks of the University.

### Senility in Plants.

IT is a very old subject of controversy whether a vegetatively propagated 'clone' can be maintained in cultivation indefinitely or whether, in the course of time, quite apart from the incidence of disease, the individuals of the clone would 'degenerate' because of their increasing age. It is true that time after time a new piece is separated, by some recognised horticultural method, and started into growth anew in some fresh location, but it is argued that such a new start does not compare with the new start made by the plant which emerges from the seed.

Any comparison is difficult, of course, because the seed results from fertilisation, and in this case the new individual is inevitably a new beginning, a fresh combination genetically, but it is still not clear that this new piece, which forms a fresh link in the series in the vegetatively propagated clone, is not just as vigorous and fresh in its growth as any average seedling of the same stock, and certainly there is still wanting definite evidence that such new individuals ultimately prove 'senile' because of the long period of time since this vegetatively propagated material emerged from a fertilised egg.

'Degeneracy' in the potato has now been traced in many cases to the cumulative effects of a transmissible virus disease, handed on with the new piece, in the process of vegetative propagation, so that its effect in successive vegetatively propagated generations begins to be exerted earlier and with more disastrous results. In many such cases, now that the etiology of the virus is better understood, it has been possible to isolate from amongst such degenerate strains healthy plants, free from virus, which seem as vigorous and productive as ever.

Nevertheless, the doctrine of senility still has advocates. A very clear and valuable summary of the literature in this controversial field is given by A. P. C. Bijnhouwer, with a comprehensive bibliography, in the *Journal of Pomology and Horticultural Science*, vol. 9, June 1931, one noticeable omission, however, is the lack of reference to the work of Dr. A. B. Stout, of the New York Botanic Garden.

### University and Educational Intelligence.

CAMBRIDGE.—Dr. C. E. Wynn-Williams, of Trinity College, has been elected to a moiety of the Clerk Maxwell scholarship vacated by W. H. Watson.

Sir F. Gowland Hopkins has been granted leave of absence for such one term as the General Board may approve in each academical year in which he holds the office of president of the Royal Society.

NOTICE is given by the Royal Society that applications for the Government Grant for Scientific Investigations must be made upon forms, obtainable from the Clerk to the Government Grant Committee, Royal Society, Burlington House, London, W. 1, and returned by, at latest, March 31.

THE eighth annual Report of the Ella Sachs Platz Foundation for the advancement of scientific investigation has recently been published. During 1931 twenty-six grants were made, nineteen of which were outside the United States. At present, researches in scientific subjects with a bearing on problems in medicine and surgery are favoured. Applications for grants for 1932 should be sent to Dr. Joseph C. Aub, Collis P. Huntington Memorial Hospital, 695 Huntington Avenue, Boston, Mass., before May 1.

AN American International Fellowship, value 1½ dollars, is being offered to women graduates by the American Association of University Women, and Spanish International Fellowship, value 4000 peset by the Cultural Relations Committee of the Spanish Ministry of Foreign Affairs. Information with reference to the fellowships and application forms obtainable from the British Federation of University Women, Crosby Hall, Cheyne Walk, S.W. 3. Completed forms must be returned by Feb. 14.

THE University of Leeds report on the year 1930-records substantial additions to its resources and increase in the number of its students. A bequest of £100,000 by Lord Brotherton, who died during the year, brought the total amount of his benefaction to the University up to about a quarter of a million sterling. A new residential hall for students open at the beginning of the year was continuously occupied to its utmost capacity and proved an unqualified success. A new building providing ample accommodation for the teaching of physics under ideal conditions was nearly completed, and good progress was made with an extensive block of buildings for the chemistry department and with a pathological institute. Other notable happenings of the year were the introduction of a system of grading of salaries and sea increases of salaries for the members of the academic staff, the celebration of the hundredth anniversary of the commencement of the medical school and the recognition of courses at University College, Hull, leading to success in the first M.B. examination of the University of London, as qualification for exemption from the first M.B. examination at Leeds.

'General science' courses and the teaching of biology in schools are discussed from various points of view in the January number of the *New Era* by Prof. Winifred Cullis, who contributes a general introduction to the other articles by Prof. Julian Huxley, whose subject is "Biology: a Cultural Subject" and half a dozen other writers. Mr. S. A. McDowall, chaplain and senior science master at Winchester College, describes the aims and content of his five years continuous course in general science for boys from 13 to 18 years of age, beginning with physics, geography and proceeding, through hydrostatics, heat, chemistry, sound and light, electricity and magnetism, and molecular physics, to biology in the fifth year, linked with the principles and history of science. He describes also how the course was gradually evolved from a discontinuous and imperfectly correlated course in which no biology was included. Miss Drummond, headmistress of the North London Collegiate School and president of the Association of Women Science Teachers, deals with some of the practical problems arising in connexion with teaching biology in girls' secondary schools. Miss von Wyses concludes a paper on "Nature Study as an Approach to Biology" with an outline of a scheme of work. Mr. S. R. Slavson, sometime director of science and industrial arts education in the Walden School, New York, contributes a paper on "Integrated Science for Young Children", in which he declares his conviction, based on ten years' experience of science teaching with children from four to sixteen years of age, that the unified science programme is superior to specialities as a means of developing scientific attitudes, arousing interest, and vitalising knowledge. There are also papers on science in South African high schools, 'rural science' in a village elementary school, and broadcast science for schools, all pointing in the same direction.

## Calendar of Geographical Exploration.

Feb 11, 1864 — Central Arabia

A Levantine Italian, Carlo Guarmani, reached Teima on a mission to buy stallions for the French. From Teima onwards Guarmani passed as a Turk. He ranged the steppe south of Teima, and was the first European to reach the ancient and famous oasis of Kheibar, with its negro population. He was sent as a prisoner to Aneiza, but from that point onwards met with no difficulties. He crossed to Jabal Shammar, where the Emir was anxious to do business with him. He went in and out of Hail, to Teima and back, visited nearly all the oases of the Jabal, and finally crossed the Nafud. Guarmani took a compass with him, and took so many bearings that he may be considered to be the pioneer of scientific cartography in central Arabia. His many cross journeys gave him opportunity to record the orography of the country, and he noted the great westward and south-westward extent of the oases and wells on which the Shammar depend. Guarmani had prepared himself for the journey by a long study of the Arab tribes, and in 1851 he had conducted an expedition to Jauf.

Feb 12, 1541 — Exploration and Conquest of Chile

Pedro de Valdivia founded the town of Santiago, whence he proceeded to establish fortified settlements north and south of that centre, and east of the Andes. The country was opened up as far south as Valdivia, founded in 1552, and beyond it to 40° S. An expedition was sent by sea to Magellan Strait, and a land expedition to that region was planned, but not carried out owing to the death of Valdivia. East of the Andes, Valdivia may have reached the Negro or the Colorado River. The province of Cuyo which he conquered is now included in the Argentine.

Feb 13, 1500 — Cumana and the Island of Margarita

Alonso Niño of Moguer, who had accompanied Columbus as a pilot, left Cumana for Spain. During his voyage, Niño had sailed to the Gulf of Paria, and his men were the first Spaniards to land on the island of Margarita, the centre of the pearl fishery. The party then proceeded to Cumana and explored the mainland to the west; gold and pearls in some quantity were obtained on this voyage and thus helped to attract other vessels to the region.

Feb 13, 1858 — Sources of the Nile

R. F. Burton and J. H. Speke reached Lake Tanganyika. They had set out to ascertain the limits of the Sea of Ujiji (Tanganyika) and to study the economic and ethnographic conditions of the region round it. They also hoped to reach 'the reputed' Lake Nyasa. They were obliged to give up the latter quest, but Speke on the return journey left Burton for a northward expedition, during which he discovered Lake Victoria Nyanza, which he was convinced was the source of the Nile. In 1860, Speke and J. A. Grant set out from Zanzibar and reached the outlet of the lake, where the Ripon Falls, the birthplace of the Nile, were discovered, on July 28, 1862. Speke also discovered the Kagera River, now known to be the most remote headstream of the Nile, though he was uncertain of this fact. Stanley, in 1875, circumnavigated Victoria Nyanza, confirming Speke's statement that it was one large lake and not five small ones as Schweinfurth had thought. He also explored part of the Kagera.

## Societies and Academies.

LONDON.

Royal Society, Jan 28 — T. M. Lowry and H. K. Gore. Optical rotatory power of vapours. The optical rotations of the vapours of camphor and of camphor quinone are  $(M)_{5893} = 83^\circ$  at  $180^\circ \text{C}$ , and  $-146^\circ$  at  $200^\circ$ , respectively. The curve of rotatory dispersion of camphor vapour shows a sharp maximum  $(\alpha)_{180^\circ} = 2000^\circ$  at  $3200 \text{ \AA}$ , followed by a reversal of sign at  $3020 \text{ \AA}$ , and a negative maximum  $(\alpha)_{180^\circ} = -1860^\circ$  at  $2800 \text{ \AA}$ . A 'step-out' on the short wavelength side of the positive maximum is in harmony with the fact that the curve of circular dichroism of a solution of camphor in hexane extends over only a part of the absorption band, on the side of longer wave-lengths. A solution of camphor in cyclohexane shows a positive maximum  $(\alpha)_{200^\circ} = 2600^\circ$  at  $3200 \text{ \AA}$ , followed by a step-out, a reversal of sign, and a negative maximum  $(\alpha)_{200^\circ} = 2100^\circ$  at about  $2720 \text{ \AA}$ . The curve of rotatory dispersion of camphor quinone passes through a negative maximum  $(\alpha)_{200^\circ} = -500^\circ$  at  $4950 \text{ \AA}$  for the vapour and  $(\alpha)_{200^\circ} = -450^\circ$  at  $4940 \text{ \AA}$  in cyclohexane, followed by a reversal of sign at  $4740 \text{ \AA}$  and a positive maximum  $(\alpha) = +300^\circ$  at  $4440 \text{ \AA}$ . — H. W. B. Skinner. The excitation potentials of light metals. (1) Lithium. There are critical potentials and also, apparently, some bands of radiation in the voltage region less than 20 volts. These must be associated with the conduction electron system. But the more important aspect of the work is concerned with the emission of the  $K$ -radiation of lithium metal. The radiation was found to consist of a band with a maximum frequency corresponding to 54 volts. It is shown that the ionisation of the  $K$ -shell alters the levels in the metal in such a way that there are empty levels around the ionised atom into which the  $K$ -electron can switch. — E. G. Cox. The crystalline structure of benzene. By consideration of the intensities of the X-ray reflections from a number of lattice-planes it has been found possible to decide on the arrangement of the molecules in the lattice, and in addition it is found that the experimental results are strongly in favour of a flat-ring molecule.

LEEDS.

Philosophical and Literary Society, Dec 8 — J. Blakey. The Schur quadrics of the trimodal cubic surface. — R. Whiddington and J. E. Taylor. Preliminary note on the photographic action of electrons. The law of blackening of a photographic film by electrons of speed within the region 50-300 volts has been studied quantitatively. The law is similar to that in the case of light. The photographic effect for a given number of electrons falling on the film is independent of their energy within the region examined. — J. Ewles. The measurement of ionisation currents by means of an alternating current bridge and valve amplifier. The ionisation chamber is used as a capacity in one arm of an alternating current capacity bridge. The balance is detected by a multistage thermionic valve amplifier in conjunction with an output transformer and alternating current detector. After a balance has been obtained and the ionisation current then allowed to disturb it, it is possible to restore the balance by a series resistance in an arm adjacent to that of the chamber, when the value of this series resistance is proportional to the ionisation. Since a compact multistage amplifier may be used, the method is capable of very great sensitivity. — G. W. Brindley. On the intensity of reflection of X-rays by perfect crystals. The observed intensities of reflection of X-rays from highly perfect diamond crystals agree

with Ewald's theory only for angles of reflection less than  $45^\circ$ , at greater angles there is a large divergence between the observed intensities and the theoretical predictions. Ewald's theory does not take into account the atomic structure factor. When this factor (corrected slightly for zero point energy in the diamond lattice) is taken into account in the manner suggested by the work of Darwin, the theoretical predictions are then of the same general form as the experimental results both at large and small angles of reflection.—F W Spiers. The diffusion of mercury drops on rolled tin-foils. Elliptical areas of amalgam (11.8 atomic per cent mercury) are formed, the crystal structure of which is found to be hexagonal.—H. M. Dawson and G V Hall. Comparison of the catalytic effects produced by acids in aqueous and in aqueous alcoholic solutions. Observations on the acetone iodine reaction show that the catalytic effects produced by buffer mixtures of the constant acid, variable salt type, are precisely the same for aqueous and aqueous alcoholic solutions.—H. M. Dawson and A. Key. Determination of ionisation constants of acids in aqueous alcoholic solutions on the basis of catalytic effects. The catalytic effect of chloroacetic acid on the acetone iodine reaction in 75 per cent alcohol has been used to determine the ionisation constant of the acid and also the catalytic activity of the chloroacetic acid molecule. The observed dependence of the reaction velocity on the concentration of the acid indicates that the ionisation of the acid conforms closely to the requirements of the mass law.—F J. Garrick. Note on the use of acidimetric indicators in argentometry. Quite accurate results may be obtained in silver titrations by the use of bromphenol blue, methyl orange, or methyl red as adsorption indicators. The method possesses no advantage in respect of accuracy over those usually employed, but is particularly convenient in the special case where both an acidimetric and an argentometric titration of the same solution are required.—E T Everingham and W H Pearsall. The effects of tartaric acid and of glucose on the metabolism of vine leaves. Both tartaric acid and glucose reduce the rate of hydrolysis of protein in vine leaves. Tartaric acid appears to reduce the rate of deamination of amino-acids, and apparently tends also to reduce the rate of carbohydrate loss. These effects are more marked in young leaves or in leaves illuminated by weak light. When glucose is supplied, there is a tendency towards protein synthesis.

## PARIS

Academy of Sciences, Dec 28.—Maurice Hamy. A property of the equation obtained on equating to zero the distance of two planets,  $P, P_1$ , which do not meet at real points.—Marcel Brillouin. The development in harmonic functions on the sphere of a function the value of which is given at each point of the continental seashore. Conformal representation.—H. Deslandres. Simple relations between the molecular spectrum and the structure of the molecule.—L. Cayeux. The secondary origin of the radiating structure of old marine oolites. Arguments are given in favour of the view that the radial structure of oolites is a secondary acquirement, and is independent of the concentric structure.—Charles Nicolle, Charles Anderson, and Jean Laigret. Study of the spirochaetes of the first three cases of recurrent Spanish-African fevers met with in Tunis.—T. Levi-Civita. Surfaces admitting a triangular network of parallel lines.—J. Drach. Remarks on the preceding communication.—E. Mathias. Lightning formed of a series of luminous lines.—Lucien Daniel. Natural layering of the aerial rhizomes of *Tanacetum Balsamita* grafted

on *Chrysanthemum frutescens*.—N. Aronszajn. The decompositions of uniform functions.—B. de Kerekjárt. The existence of square roots in continued groups.—B. N. Prasad. The summability of a conjugated series of a Fourier's series.—C. Visser. The angular derivative.—J. Le Roux. The rôle of the group of relativity in classical mechanics.—J. Haag. The gravity pendulum.—D. Barbier. The probable eccentricities of the visual double stars the orbits of which are still unknown.—Emile Sevin. Concerning binary systems.—F. Holweck. A new model of the Holweck-Leja pendulum. The value of gravity at points in continental France and in Corsica.—Henri Abraham. The maintenance of a room at constant temperature. The room was electrically heated and the temperature controlled by a toluene thermostat. Artificial ventilation was found to be necessary. With the precaution described, the average daily temperature was kept constant within  $0.001^\circ \text{C}$ .—Henri Chaumat and Edouard Lefrand. Electrostatic machines.—Duffieu and G. Trolet. The luminous phenomena produced by the rolling of amalgams on glass in a vacuum. The experiments with mercury described in a previous note have been repeated with mercury containing known amounts of impurities (zinc, cadmium, sodium).—R. de Malleman and P. Gabiano. The magnetic rotatory power of argon. The Verdet constant of argon at  $0^\circ \text{C}$  and 760 mm pressure is  $9.2 \times 10^{-6}$ . The magnetic rotatory power of argon is higher than that of nitrogen, oxygen, or hydrogen.—J. Cabanne and Mlle Osborne. Theoretical considerations on the anomalous depolarisation of the Raman lines in uniaxial crystals.—Mme Irène Curie. The nuclear  $\gamma$ -radiation excited in beryllium and in lithium by the  $\alpha$ -rays of polonium.—F. Joliot. The excitation of the nuclear  $\gamma$ -rays of boron by  $\alpha$ -particles. The quantum energy of the  $\gamma$ -radiation of polonium.—P. Lecomte du Nouy. The measurement of the hydrogen ion concentration of liquids by means of a rotatory electrode. With the form of electrode described, equilibrium is attained in less than one minute and the quantity of liquid required is 1 c.c. or less.—A. Girard and G. Chaudron. Contribution to the study of ferromagnetic ferric oxide. Four specimens of ferromagnetic ferric oxide were studied, one natural lepidocrocite and the others prepared by laboratory methods. Curves showing the changes produced in the magnetisation by rise of temperature are given.—Hikoichi Shiba and Tokunosuké Watanabé. The structures of crystals of northupite, bromonorthupite, and tychite.—Mlle. Foret. Calcium chromo-, selenio-, and sulphoaluminates.—E. Carrière and Juillard. Evolution of the system iodine, excess of soda.—R. Paul. Some derivatives of the tetrahydrofuryl series.—Marcel Godchot and Pierre Viéles. The dilactic acids.—Léon Enderlin. Researches on the chemistry of the rubrenes. The chemical properties of rubrene and its homologue dimethylrubrene were compared and found to be closely parallel.—R. Delaby, R. Charonnat, and M. Janot. The radioactivity of the waters from some summits of the Vosges. The waters examined were collected at heights between 700 metres and 1315 metres above sea-level. It was found that the radioactivity of the granites and that of the waters flowing from them varied in the same sense.—P. Idrac. A submarine temperature recorder. An electrical recording thermometer modified to meet the special conditions, and capable of an accuracy of  $0.01^\circ \text{C}$ . A typical record is reproduced.—Frank A. Perret. The new dome of Mt Pelée.—R. Lamé. The geographical distribution of some marine algae in the northern region of the coasts of Portugal.—P. Choux. *Stapelopsis Madagascariensis*, a cactus-shaped *Ceropegium* of Madagascar.—E. Bigeard. The *Pedrastrum*

of France — Pierre Lesage Contributions to the study of the exchange of seeds of the same species of plant between two different stations

(To be continued)

#### ROME

Royal National Academy of the Lincei Communications received during the vacation — G Armellini A new cosmogonic interpretation of the equipartition of energy among the stars If the cosmogonic hypothesis of Sir Norman Lockyer and R Du Ligondès—according to which nebulae and stars were originally formed by the union of large numbers of pre-existing meteorites—is accepted, the equipartition of energy among the stars follows as a mathematical consequence This result throws doubt on the conclusion of Jeans, who, by comparing the movements of the stars with those of gas molecules, calculated that impacts of stars over a period of at least five to ten million million years would be necessary to effect equipartition of their energies — F Zambonini and Silvia Restaino Double sulphates of rare earth and alkali metals (14) Sulphates of praseodymium and sodium Study of the isotherm of the system  $\text{Pr}_2(\text{SO}_4)_3 \cdot \text{Na}_2\text{SO}_4 \cdot \text{H}_2\text{O}$  for  $25^\circ$  shows the existence of two crystalline compounds of the formulae  $4\text{Pr}_2(\text{SO}_4)_3 \cdot 5\text{Na}_2\text{SO}_4 \cdot 8\text{H}_2\text{O}$  and  $\text{Pr}_2(\text{SO}_4)_3 \cdot \text{Na}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$  — L Cambi and A Cagnasso Manganic dithiocarbamates Manganic *N*-piperidyl-, *N*-*N*-isodibutyl-, and *N*-*N*-dibenzyl-dithiocarbamates are described — G Rovereto Folds with inclusions (*a truciolo*) and two-way folds — G Barba Generalised parallelism in a  $V_3$ -C Miranda Asymptotic properties of Newtonian potentials due to illimited distribution of masses — P Clemente Majoration of the periodic solutions of an ordinary linear differential equation of the second order — A Rosenblatt The stability of the laminar movements of incompressible viscous liquids — A Masotti The centre of hydrostatic pressures — G Occhialini A magnetic spectrograph for  $\beta$ -rays emitted by feebly radioactive substances A description is given of a simple magnetic spectrograph which allows of the use of a wide irradiating surface and is especially useful for the examination of feebly radioactive substances like rubidium and potassium — C Dei A dynamic arrangement for comparing the constants of two triodes — Zvi Jolles Study of the oxidising properties of normal diazo-hydrates Various reactions indicate that the oxidising properties of diazo-hydrates are very general in character — F De Carli Viscosity of mixtures of stannic chloride with aromatic hydrocarbons The viscosity isotherms of mixtures of stannic chloride and toluene show that, unlike benzene, toluene is able to associate appreciably with stannic chloride at temperatures between  $20^\circ$  and  $30^\circ$ , but the data obtained are insufficient to prove the existence of a definite compound between the two substances — E Parisi The presence of a new sugar in dextro-rotatory honeys Conifer honeys contain, in addition to the sugars of other honeys, a glucobiose which has a molecular weight, determined cryoscopically, varying from 280 to 340 according to its degree of purity, and a specific rotatory power of  $+90^\circ$  to  $+110^\circ$  The sugar may occur ready-formed in the tree or may result from an enzymic action similar to that which gives rise to Croft Hill's revertose — G B Cacciamali Orogenic conflicts — A Debenedetti A method of measuring the maximum birefringence of biaxial minerals with the help of the Federow plate The method described allows of the determination of the maximum birefringence of a mineral from the two refractions corresponding with two positions of a section maintained normal to a principal plane of optical symmetry — G Tallarico The volume of

the caryopses of grain in relation to their nutritive value The results of experiments with turkeys show that small-corned grain has a greater nutritive and biological value, at any rate during the development and growth of the birds, than grain with large corns — M Curzi A new species of *Helminthosporium* in a disease of the banana encountered in Italian Somaliland This disease, manifested by spots on the stems, leaves, etc., is due to the organism *Helminthosporium gibberosporum* n. sp. — Giulio Cotronei and Aldo Spirito Zoological constitution and grafting New experiments between Anura and urodeles — Aldo Spirito Grafting from the triton to the edible frog (2)

### Forthcoming Events.

#### Societies

#### FRIDAY, FEBRUARY 5

- ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5 — Discussion on Common Colds and their Sequelae  
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 — Prof A R Hobbs Puerperal Sepsis, with an Account of the Treatment of Puerperal Infection by Glycerine Drainage (Hunterian Lecture)  
GEOLOGISTS' ASSOCIATION (in Botany Theatre, University College) (Annual General Meeting), at 7 30 — Prof W W Watts Fossil Landscapes (Presidential Address), and presentation of Foulerton Awards to F Gossling and Dr S W Wooldridge  
ROYAL INSTITUTION OF GREAT BRITAIN, at 9 — Dr G C Simpson Weather Forecasting

#### MONDAY, FEBRUARY 8

- ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 — Prof J A Ryle The Natural History of Duodenal Ulcer (Hunterian Lecture)  
ROYAL GEOGRAPHICAL SOCIETY, at 8 30 — H Clutterbuck The Oxford Expedition to Akpatok Island

#### TUESDAY, FEBRUARY 9

- ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 — Dr G Shearer Research Work on Crystal Analysis (1)  
INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at College of Technology, Manchester), at 7 30 — Prof J K Catterson-Smith Everyday Uses of Electricity (Faraday Lecture)  
QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W 1), at 7 30 — Annual General Meeting  
PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8 30 — Dr H E Archer Biochemistry, Chemical Pathology, and Pharmacy (Address)

#### WEDNESDAY, FEBRUARY 10

- ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 — Prof H A Harris The Comparative Anatomical Aspect of Pre-Natal, Infantile, and Adult Disease in Man and Animals, with special reference to Bone Growth (1) (Hunterian Lecture)  
ROYAL SOCIETY OF ARTS, at 8 — J A R Stevenson The Craft of the Decorative Iron Worker (Lecture)

#### THURSDAY, FEBRUARY 11

- ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 — Prof H G Cannon Feeding and Digestion in Invertebrates (4)  
INSTITUTION OF MECHANICAL ENGINEERS (at Leeds), at 7 30 — Lt B Atkinson The Mechanical Aspects of Electricity (Thomas Hawksley Lecture)  
INSTITUTION OF WELDING ENGINEERS (at Institution of Mechanical Engineers) — Declaration of name of prize winner, Award of Prize and Gold Medal, Paper by or on behalf of prize winner Welding and Cutting on Railways and Tramways

#### FRIDAY, FEBRUARY 12

- ROYAL ANTHROPOLOGICAL INSTITUTE (Sociological Research Committee) (at 52 Upper Bedford Place), at 4 —

- Mrs. Seligman The Method of Exhibiting Genealogical Data—C W. M. Hart Is it correct to regard all Australian Tribes as on the same Economic Level?  
 ROYAL ASTRONOMICAL SOCIETY, at 5—Anniversary Meeting  
 ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5—Prof H A HARRIS The Comparative Anatomical Aspect of Pre-Natal, Infantile, and Adult Disease in Man and Animals, with special reference to Bone Growth (2) (Hunterian Lecture)  
 ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Sir John Cadman Petroleum A Record of Achievement in Applied Science

## Public Lectures.

## FRIDAY, FEBRUARY 5

- UNIVERSITY COLLEGE, at 5 30—H N Gresley High Pressure Locomotives—Prof H A R Gibb The Climax of Arab Culture

## SATURDAY, FEBRUARY 6

- HORNIMAN MUSEUM (Forest Hill), at 3 30—Prof J. R. Answorth-Davis Shell-Fish in relation to Man

## MONDAY, FEBRUARY 8

- GUY'S HOSPITAL (in Physiological Theatre), at 5—Prof H A HARRIS The Use of X-Rays in Physiological Investigations (2)  
 ST BARTHOLOMEW'S HOSPITAL MEDICAL COLLEGE, at 5 30—Dr L Findlay The Feeding and Nutritional Disease of the Infant (1)  
 KING'S COLLEGE, LONDON, at 8—C J Gadd Babylonian Myth and Ritual

## TUESDAY, FEBRUARY 9

- UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5 15—Prof A E Boycott Hypertrophy and Atrophy (1) (Succeeding Lecture on Feb 16)

## WEDNESDAY, FEBRUARY 10

- ROYAL INSTITUTE OF PUBLIC HEALTH, at 4—Dr M. B. Ray The Prevention and Treatment of Industrial Rheumatism  
 SCHOOL OF ORIENTAL STUDIES (jointly with Royal Anthropological Institute), at 5—Dr R S Rattray Hausa Poetry  
 UNIVERSITY COLLEGE, at 5 30—Dr. R S Hutton The Field of Industrial Librarianship  
 BELFAST MUSEUM AND ART GALLERY, at 8—O Davies The Great Days of Egypt

## THURSDAY, FEBRUARY 11

- ST BARTHOLOMEW'S HOSPITAL MEDICAL COLLEGE, at 5 30—Dr L Findlay The Feeding and Nutritional Disease of the Infant (2)  
 KING'S COLLEGE, LONDON (at 16 Russell Square, WC 1), at 6—S P Turn Economic Conditions in Russia To-day Accumulation of Capital and Savings under the Five-Year Plan

## FRIDAY, FEBRUARY 12

- ST BARTHOLOMEW'S HOSPITAL MEDICAL COLLEGE, at 5 30—Dr L Findlay The Feeding and Nutritional Disease of the Infant (3)  
 UNIVERSITY COLLEGE, at 5 30—Prof Sir Reginald Fleming Johnston China in the Ancient World

## SATURDAY, FEBRUARY 13

- HORNIMAN MUSEUM (Forest Hill), at 3 30—Mrs Olwen Brogan Town-Life in the Roman Empire

## Conferences.

## SATURDAY, FEBRUARY 6.

- SCHOOL NATURE STUDY UNION (in Botanical Theatre, University College), at 3—Sir Arthur W Hill The Andes of Bolivia, with some Account of the Archaeology and Botany of the Region

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## TUESDAY, FEBRUARY 9

CONFERENCE ON MECHANISATION AND BRITISH AGRICULTURE (at Rothamsted Experimental Station, Harpenden), at 11 30 A M

- J E Newman Engineering Developments and Possibilities  
 Prof J A S Watson Combination of Livestock with Systems of Mechanised Farming  
 Sir John Russell The Maintenance of Soil Fertility under Mechanised Farming Systems

## Official Publications Received.

## BRITISH

- Department of Scientific and Industrial Research. Water Pollution Research Summary of Current Literature Vol. 5, No. 1, January Abstracts Nos. 1-123 Pp 36 (London H M Stationery Office) 2s net  
 Winchester College Natural History Society Report 1927-1931 Pp 63+8 plates The British Palmate Orchids By H Cary Gilson Pp 36+35 plates 3s (Winchester P and G Wells, Ltd)  
 War Office Report on the Health of the Army for the Year 1930 Vol 66 Pp 11+161 (London H M Stationery Office) 2s 6d net  
 The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 70, No 421, January Pp 105 188+xxvi (London E and F N Spon, Ltd) 10s 6d  
 Proceedings of the Royal Society of Edinburgh, Session 1930 1931 Vol 51, Part 2, No 22 An Operational Method for the Solution of Linear Partial Differential Equations By W O Kermack and W H McCrea Pp 176 159 1s Vol 51, Part 3, No 23 An X-ray Examination of d-Mannitol and d-Mannose By Dr George W McCrea Pp 190 197 1s (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd)  
 Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society Edited by H Munro Fox Vol 7, No 1, January Pp 57 (Cambridge At the University Press) 12s 6d net

## FOREIGN

- Library of Congress Report of the Librarian of Congress for the Fiscal Year ending June 30, 1931 Pp vi+468+19 plates (Washington D C Government Printing Office)  
 Report of the Aeronautical Research Institute, Tokyo Imperial University No 76 The Buckling of a Cylindrical Shell under Torsion By Katsutada Sezawa and Kei Kubo Pp 251-314 (Tokyo Koseika Publishing House) 0 53 yen  
 Science Reports of the Tokyo Bunrika Daigaku Section A, No 14 On the Zero Points of a Limited Function By Soichi Kakeya Pp 159 165 (Tokyo Maruzen Co., Ltd) 15 sen  
 Ministry of Public Works, Egypt Physical Department Meteorological Report for the Year 1925 Pp viii+176 (Cairo Government Press) 46 P T  
 Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia Verhandelingen No 24 Regenval in Nederlandsch-Indie (Rainfall in the Netherlands Indies) Door Prof Dr J Boerema Deel 1 Gemiddelde van den Regenval voor 3293 Waarnemingsplaatsen in Nederlandsch-Indie berekend uit Waarnemingen verricht in het tijdvak 1879-1928 (Mean Rainfall Figures for 3293 Rainfall Stations in the Netherlands Indies calculated from Observations made during the period 1879-1928) Pp iv+244 Deel 2 14 kaarten (Batavia Landsdrukkerij)  
 Annual Report of the Board of Regents of the Smithsonian Institution showing the Operations, Expenditures and Condition of the Institution for the Year ending June 30, 1930 (Publication 8077) Pp xii+656 (Washington, D C Government Printing Office) 2 00 dollars  
 State of Connecticut Public Document No 24 Fifty fourth Report of the Connecticut Agricultural Experiment Station, New Haven, for the Year 1930 Pp xii+764+68 (New Haven, Conn)  
 Collection des travaux chimiques de Tchécoslovaquie Rédigée et publiée par E Votoček et J Heyrovsky Année 3, No 12, décembre Pp 563 593+xxiv (Prague Regia Societas Scientiarum Bohemica)  
 Special Publication of the American Committee on International Wildlife Protection Vol 1, No 1 Report on the available Evidence showing the relation of Game to the spread of Tsetse fly borne Diseases in Africa By Richard P Strong, Joseph C Bequaert and L R Cleveland Pp 46 (London Society for the Preservation of the Fauna of the Empire)  
 Institut de France Académie des sciences Annuaire pour 1932 Pp 402 (Paris Gauthier-Villars et Cie)  
 U S Department of Agriculture Circular No 196 The Blueberry Maggot and its Control in Eastern Maine By F H Lathrop and L C McAlister, Jr Pp 14 5 cents Miscellaneous Publication No 126 Fertilizers for Cotton Soils By J J Skinner Pp 10 5 cents (Washington, D C Government Printing Office)  
 Smithsonian Institution United States National Museum Report of the Progress and Condition of the United States National Museum for the Year ended June 30, 1931 Pp ix+223 (Washington, D C Government Printing Office) 25 cents

## CATALOGUES

- Moll Recording Microphotometer (MF 20) Pp 8 (Delft P J Kipp and Zonen)  
 Standard Meteorological Instruments (List M2) Pp 140 (London Negretti and Zambra)  
 Fine Chemical Products for Laboratory Use Pp 60 Catalogue of Scientific Text Books, Dictionaries and Encyclopaedias (List No 98 Pp 24. (London A. Gallenkamp and Co., Ltd)  
 A Catalogue of Book Bargains (No 533) Pp 16 (London Willmar Glasgow, Ltd)





SATURDAY, FEBRUARY 13, 1932

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## International Co-operation

THE unanimity with which some form of deliberate planning of our national resources and of our industrial if not of our social and economic life has been suggested in technical journals of high standing and ranging over chemical industry, engineering, and the electrical and gas industries is highly significant, and is evidence of the growing realisation that a scientific age can only be safe if the powers of science are exercised with wisdom. In a speech at the annual dinner of the British Association of Chemists, Dr E. F. Armstrong, after referring to the lack of scientific knowledge on the part of many of the world's political leaders, their opportunism and lack of definite plans, urged that chemists with other scientific workers should use their influence in industry and professionally in support of leaders who would attempt to plan the international reconstruction of the world on the basis of a definite five-year or similar plan.

It is not industry alone, however, which is insisting that problems of to-day require solution on world lines by scientific method. Even in the political sphere, the only real pieces of successful reconstruction work in post-War Europe have been schemes based on an impartial scientific analysis of the problem by the relevant experts and linked up with the appropriate action. The Austrian and Hungarian reconstruction schemes and the Greek Refugee Settlement scheme are examples of a new technique in international questions, and demonstrate beyond question the function of the technical expert in linking up knowledge and power.

The recently published report of the Basle Committee of Experts demonstrates how imperative is the need for concerted action if financial paralysis of the world is to be avoided. The dislocation at present taking place may well involve a profound change in the economic relations of one nation with another. Referring to this essential need for international co-operation, in an address on world unemployment to the Institute of International Relations at Geneva, Prof P. H. Douglas, of the University of Chicago, pointed out that it is doubtful whether the fierce national jealousies of the world would permit the required pooling of resources and common policy, and that the issue depends upon intelligence as well as upon goodwill. There is much in the preliminary negotiations regarding the Lausanne Conference which indicates that such doubts are well founded and political prejudices still unwilling to recognise facts.

In another field we find that Major Lefebure's plea for a scientific study of the disarmament problem, and in particular for the creation of a representative scientific organisation under the League of Nations to advise on actual means for giving effect to international policy as to research on armament type, has been passed over in making preparations for the present Disarmament Conference. Further, the results of the impartial scientific investigations of many of the vexed and difficult problems related to the South Manchuria railway which have been carried out during recent years by the Institute of Pacific Relations have been brushed aside by politicians. The lack of courage, foresight, and understanding displayed in the handling of the Manchurian dispute can only be rightly assessed when we consider how much has already been provided by scientific investigations as a basis for an impartial settlement.

These recent events demonstrate that the gap between knowledge and power to which Prof Zimmern directed attention some years ago in his brilliant study, "Learning and Leadership", has become a dangerously critical problem. Leadership has definitely weakened under the pressure of public opinion, and more and more the only hope of solving vexed problems is in entrusting the handling of them to impartial experts who are not dependent upon public opinion. The Dawes and Young Commissions were not only valuable because of the great work they did, but even more because they are typical of a new method of dealing with such questions. They applied the forces of science and expert skill and wisdom to a problem declared insoluble by governments and hopelessly vitiated by human prejudice. That their solution was only temporary and that the problem threatens to be sucked once more into the maelstrom of politics merely indicates the imperative need for extending this same technique to other international problems which react on these issues.

"Statesmen are not enough to solve the problems which arise in international affairs", General Smuts has said in a lecture on "Democracy". "The nations must become accustomed to look to the organised system of the expert report, which gives a just and impartial lead to governments and public opinion and should be regularly accepted just as judicial decisions are accepted as a matter of course."

Not only the discoveries of science, but the mature, sober, impartial spirit of science is what is above all else necessary for the functioning of the new international system. The application of the true scientific spirit to human affairs, if it were humanly possible, would mean such a reign of justice and fair play on earth as only poets have

dreamt of. The cool, serious, gentle spirit of science, above all, wanted in the storm-tossed domain of international affairs. The scientific expert must prove a most valuable link in the international organisation of the future. He will function normally and dispassionately, whether international storms may rage outside, and his findings will be quietly accepted in the end, as the higher wisdom and the better way."

In the last two years a beginning has at any rate been made on some of the problems which arise out of the application of scientific method to international affairs. At a Conference of Institutions for the Scientific Study of International Relations held in Copenhagen in June 1931, progress was made in the fundamental study of international relations, and the possibility of a systematic study of actual problems on international relations, either on the lines of the Institute of Pacific Relations, or by entrusting particular researches to individual institutions, was discussed. A study of the international implications in the relations between government authority and private economic activities of individuals and groups, with special reference to the new forms of public management, control, and supervision, national or international, direct or indirect, which have grown up since the War, and the motives and policies underlying them is contemplated at the next Conference. The possibility of a fundamental scientific study of the problem of disarmament was also suggested.

In industry, where an international outlook has become much more prevalent and the importance of scientific leadership is increasingly recognised, the possibilities visualised by General Smuts have found even more concrete expression. Sir Harry McGowan has already thrown out the suggestion of an International Council for Chemical Industry which would plan chemical industry as a world unit in regard to production, research, and development. The World Social Economic Conference held at Amsterdam last August led to definite proposals for a five-year world plan which was to be based on world solidarity, the modification of national economic policy in accordance with its effect on world economy, and the pooling of losses due to the War. The plan involves a general moratorium on all war debts and reparation payments, a series of international loans and agreements in regard to markets and production, and the establishment of a World Research Council or Planning Board to stimulate thought and action in the planning and rational organisation of the social and economic life of the world.

Were not scientific workers, as Ruskin remarked

"still eager to add to our knowledge, rather than to use it", the new opportunities confronting them of making a vital contribution to the solution of our present difficulties would have been seized with avidity. Not only industry but also whole sections of the nation are disposed to accept the leadership of science and to adopt a well-thought-out and comprehensive scheme of national and international reconstruction based upon an authoritative and scientific analysis of the whole situation. No such scheme can, however, be produced until scientific workers are sufficiently concerned with the economic and social consequences of their work to co-operate with industrialists and others who are imbued with the scientific outlook and capable of assessing the value of scientific method and knowledge. In such co-operation there should be adequate safeguard against the neglect or abuse of human values, which Bertrand Russell fears and depicts so vividly in his sketch of scientific society and scientific government.

There are all the signs that the age of individualism and competition is passing and will be succeeded by an age of co-operation and planning on a world scale. The danger is still acute that old prejudices may delay the transition and precipitate a conflict from which the recovery of civilisation will be impossible. The existence of political prejudices in government circles should not lead us to overlook the facts that nowhere does prejudice and individualism linger more persistently than among the very scientific workers whose discoveries have made world co-operation and the renunciation of war at once inevitable and urgent. Even the difficulties and limitations on the intellectual classes and the intellectual progress of mankind directly imposed by the burden of armaments under present conditions have not sufficed to rouse general interest among scientific workers, or to induce them to make their fitting contribution in the analysis of the problem. Statesmen, indeed, need to take account of our prejudices as well as of the facts of life. Reason alone may be an incomplete guide for the control of human affairs and lead us into a tyranny which becomes intolerable to human nature because of its disregard for human values. Knowledge and leadership must be indissolubly linked if disaster is to be avoided, and to no class of the community is there a stronger challenge in the present emergency than that addressed to scientific workers to declare with a united and unequivocal voice the potentialities of science in the evolution of a better world order and the lines upon which a systematic policy can be evolved.

### Horrors of the Next World War

*What would be the Character of a New War?*

Enquiry organised by the Inter-Parliamentary Union Pp xviii+411 (London P S King and Son, Ltd, 1931) 16s net

THE appearance of this volume is opportune in view of the Disarmament Conference now sitting, it contains eighteen articles contributed by eminent writers of various nations, mostly military men or university professors. Four of them are written by Frenchmen, three each by Englishmen and Germans, and others by men born in Sweden, Japan, Denmark, Switzerland, Russia, and Greece. Each author was evidently assigned a certain aspect of modern warfare, except that in some cases there are several articles on the same subject, but this plan has some disadvantages, because it was no one's duty to sum up the often conflicting conclusions, or to consider specially the fundamental nature of war. It was neglect of this last, or a too hasty generalisation from the character of a few recent conflicts, that led to the disillusion of the War of 1914-18 and of the subsequent conferences and conventions. Major Bratt and Lieut Sergel, of Sweden, do, however, discuss the matter in the first four pages of their paper on aerial weapons and future war, and Prof Politis (of Greece), in the final article dealing with the future of international law on warfare, says a few words on the subject.

The object of war is, of course, to defeat the enemy so effectually that he must sue for peace, and the best way to do this is to destroy a great part of his armed forces, so that he shall feel that further struggle is useless. If, however, the state of armaments be such that the powers of defence are greater than those of offence, mobile warfare becomes practically impossible, and then the invading army may make war upon the civil population, so that their miseries may induce an overwhelming desire for a cessation of hostilities. This is what happened in the Middle Ages, when the fortifications of the towns were able to withstand the assaults of hostile armies. Except in England, the sufferings of the ordinary people were terrible in every part of Europe in spite of the fact that Christian principles were professed far more then than now. In the eighteenth and nineteenth centuries artillery had reduced the value of fortresses, with the result that wars were of comparatively short duration, and were confined to the armed forces. The peoples were not affected to the same extent in this period, and a body of law on

warfare grew up in the belief that this was the normal nature of war

In the War of 1914-18 the development of railways and other modern means of transport rendered it possible to keep so many soldiers in the field that the whole line between the conflicting nations could be fortified. So, after the first brief attempt to settle the dispute by mobile warfare, it settled down to a state of siege. In the last years of the War the improvements in aeroplanes, and the increase in their numbers, rendered it possible to attack the civilians far from the front, and this was consequently done. At the same time naval warfare degenerated into attempts at blockade, and each side tried to starve out the other—men, women, and children.

As regards the next war, some of the writers are of opinion that it would resemble the last. For example, General Réquin (of France) sums up his article on modern developments with the words. "The general military character of a future war would largely resemble that which the war of 1914-18 assumed in its last phase." Others, however, advance good reasons for thinking that it would be very different and probably much more terrible. General Fuller, in his article on the mechanisation of warfare, prophesies that the campaigns of the future will be settled mainly by fleets of tanks, which will be manned by comparatively small armies of highly trained men. Large masses of infantry and artillery will, nevertheless, still be required to occupy the territory conquered, or to defend their country against invading tanks. It is likely that at the commencement of hostilities neither side will have a sufficient number of these mobile forts to bring matters to a decision, but the course of events will soon cause them to be built. The side which first acquires a superiority in this arm will win.

The other important new factor will be the enormous numbers of aeroplanes. According to Bratt and Sergel, the first objective of the air force will be the corresponding force of the enemy, including his aerodromes. The second will be the enemy's land forces, upon which, however, they will not have much direct effect. If the combined action of the land and air forces does not succeed in destroying the enemy's army in a short time, part of the air force will be used to attack the enemy's centres of industry with the hope of paralysing his war effort. In this the civilians must suffer severely, even if the bombing be not carried out with the deliberate object of striking terror into them. Chemical warfare is not likely

to have a decisive influence on the struggle, but will add to its horrors. Prof Politis quotes the following description by Prof Noel Baker of what is likely to happen.

"Aeroplanes light fires that cannot be extinguished, setting whole districts aflame, illuminating the town, and thus making it impossible to take shelter. Bombs blow up the public buildings at the defence posts. The people are forced to take refuge in the streets. Then come the gases which in their present form, are fatal whatever part of the body they touch. These gases, heavier than air, penetrate everywhere, into cellars, into the underground railways, permitting no escape. A bombardment of a few hours over Paris, Berlin, London could make at least 500,000 victims."

There is no reason to think that this picture is over-drawn, and indeed there are other similar ones in the book. Nearly all the eighteen writers are of the opinion that the agreements not to use aeroplanes for bombing civilians and to renounce chemical warfare will become 'scraps of paper' when war breaks out unless their use can be prevented. But it would appear to be less difficult to stop war altogether. In the last sentence of the volume Politis says: "The real policy of peace should be to prevent war, not to humanise it. Failing such a development of public opinion the wars and armaments will become impossible, it is doubtful whether our civilisation can survive."

ARTHUR MARSHALL

### The Dynamics of Wind

*Manual of Meteorology* By Sir Napier Shaw, with the assistance of Elaine Austin. Vol. 4. *Meteorological Calculus, Pressure and Wind*. (A revised edition of Part 4, 1919.) Pp. xx + 360 + xi. (Cambridge: At the University Press, 1931.) 30s. net.

METEOROLOGISTS the world over will be pleased that Sir Napier Shaw, the doyen of their international conferences, has been able in spite of advanced years to finish and revise, with the very efficient help of Miss Elaine Austin, his elaborate treatise on meteorology.

In meteorology elaboration is inevitable. School boys have confidence in their calculations when the result is a simple number. Einstein has somewhere remarked that he was guided towards the theory of relativity partly by the notion that the universe is essentially simple. R. H. Fowler has been heard to say that of two theories the more elegant is probably the more physically correct. If such eminent physicists could be persuaded to attend to meteorology

logy, that science would be greatly enriched, but they would probably be forced to abandon the faith that Nature is essentially simple

This volume, which is more than twice as long as its 1919 edition, and includes many references to recent publications, bears the title "Meteorological Calculus, Pressure and Wind". Entropy also is frequently considered in its connexion with wind. The subject matter is arranged more or less in the following sequence: (1) A verbal account of the forces concerned. (2) Photographs of typical anemograph traces. (3) The general dynamical and other equations for a compressible fluid covering a rotating earth. (4) A review of the attempts that have been made to use fairly general equations. (5) The geostrophic approximation in which the pressure gradient is regarded as balanced by the Coriolis force due to the earth's rotation. (6) The effect of turbulence on the mean direction and velocity of the wind near the ground. (7) The effect of turbulence on cloud sheets. (8) Observations obtained by watching free balloons through theodolites. (9) The effect of horizontal temperature-gradient on the change of wind with height, including an elegant theory. (10) The graphic analysis of atmospheric motion. (11) A second approximation including not only the earth's rotation but also the curvature of the track on the map. (12) Cyclones and anticyclones, conventional and real, but with attention chiefly to their rotation. (13) The meeting of tropical with polar air and the resulting conversion of heat energy into motion, with the formation of cyclones. (14) Under the motto—

We look before and after  
And pine for what is not—

the book ends with a retrospect of the four volumes of which it is the last

There is in some textbooks a sort of clarity which is attained by mentioning only the simplest types of phenomena, by leaving out all inconvenient qualifications and by looking at the subject steadily from one point of view. The reader will not find that sort of clarity in this book. Instead, phenomena are considered in their actual complexity, qualifications are made prominent and the point of view wanders among the observational, mathematical, historical, administrative, and poetical aspects. Portions of information which seem to have come from one chapter have diffused into other chapters, like cumuli into the blue sky. Sir Napier "bloweth where he listeth", and it would be hard to tell whence he cometh or whither he goeth, were it not that there is a full index and a summary of the contents of the four volumes

Sir Napier has endowed meteorology with a number of admirably descriptive and euphous technical terms, including "geostrophic" and "tephigram". The reader should be forewarned of the queer notation "*bb*" for barometric gradient. According to V. Bjerknes an atmosphere is termed 'barotropic' if the density is either constant or *any* function of the pressure only. This term is valuable because barotropic conditions are often assumed in the older mathematical theories but seldom occur in observational data. It is regrettable that on p. 298 'barotropic' is wrongly defined by being restricted to the *special* function  $p\rho^\gamma = \text{constant}$ .

This volume is entitled a "calculus", but words predominate. The mathematical inquirer will find in it his observational raw material discussed by authors of wide experience, with the aid of about eighty diagrams. He will also find plentiful warnings against the approximations to which mathematicians are disposed, several important theories fully and clearly set out, and many useful references to mathematical papers old and new. But unsatisfying or mysterious summaries will probably drive him to the original works.

L. F. R.

### Homer's Natural History

*Die homerische Tierwelt*. Von Prof. Dr. Otto Korner. Zweite, für Zoologen und Philologen neubearbeitete und ergänzte Auflage. Pp. iv + 100. (München: J. F. Bergmann, 1930.) 6 60 gold marks.

THERE is no one quite like Homer to those who love him. He is so simple yet so great, so easy to understand and withal so noble, that a shadowy friendship, firm and intimate at last, grows up between us; there are few great poets who can make friends as he can with mortal men. When one does get to know Homer the friendship lasts a lifetime, and one comes to feel what Mr. Pope calls "a certain complacency in his company". Hard by my own door a scholar lives who knew his Homer by heart, every single word of him, a lifetime ago, and who has kept his friendship from youth to age, and in just the same way a certain old physician of Rostock, Prof. Otto Korner, has had Homer for a close and lifelong friend.

Fifty-two years ago, Prof. Otto Korner published, and now he has revised and enlarged, this little book on Homer's natural history, later on he wrote on Homer's and Hesiod's knowledge of the bee, and only a couple of years ago he wrote, fully and learnedly, on Homeric medicine and surgery. These cover and include Homer's

anatomy and physiology, which, as Daremberg has told us, are as admirable as those of the "Corpus Hippocraticum." In this last little book Dr Korner told us, for example, just how, when Idomeneus had thrust his lance right into the heart of Alcathous, the last heart-beats caused the shaft to quiver or what that Nepenthes was which Helen put into the wine-cup, or how, in August and September, the Dog-star brought malaria (πολλὸν πυρετόν) to mortal men.

Natural history never stands by itself in Homer, it lies in the background of the picture, and comes in by way of apt allusion and similitude, it is drawn from an unspoiled land, where wild life was plenteous, and wolf and eagle almost as familiar as grasshopper and nightingale. So the poet's allusions were all within the common experience of his hearers, and sometimes a phrase was enough to indicate them, and sometimes they were painted in with loving elaboration. Blind as he was, there was little Homer did not know, he knew the cuttlefish and his suckers, and how the wolf on the mountain-side has a narrow tongue and laps like a dog. Here at random are a few of the old familiar similes.

When Sarpedon and Patroclus quarrelled they looked like two angry vultures on the ground, rushing together with flapping outspread wings,

They cuff, they tear, they raise a screaming cry,  
The desert echoes and the rocks reply.

In a famous passage (Milton knew it well) the Trojan host is marshalled like the migrating cranes, noisily but in order, it is one of the noblest spectacles in ornithology. Penelope bids her returned but yet unrecognised husband sit a while longer and pass the evening hours, for then she sits alone and grieves—as does the nightingale. Then comes a dreadful story of the wanton handmaidens and how they met their punishment, and beat the air with twinkling feet,

Thus on some tree, hung struggling in the air,  
The doves and thrushes flap their wings in air.

A more cheerful picture is that of the old men sitting in the gate,

Chiefs who no more in bloody fights engage,  
But wise thro' time and narrative with age,

wisely or no, they chatter all day long—like the cicadas chirruping in the sun. The old men's garrulity, their delight in company, the thin sound, the high treble, of their old voices, their pleasure in the sunshiny day, are all told imitatively, and almost in a word. A very different picture is that of Achilles' Myrmidons on the warpath, a grim, terrific, formidable band, wolf-like, with lolling

tongues, gorged but insatiate, it is the savages and most terrible picture in all Homer.

Dr Korner does not write eloquently or poetically, like most classical commentators his job is to look for the prose behind the poetry but he deals very competently with his theme. There are a few stories which he does not tell. He knows that Odysseus is compared, in a certain passage, to a ram—a dubious comparison, but he does not help us (I cannot recall a single commentator who does) by explaining that this particular ram (κτίλος) is the old wise leader of the flock, *dux ovium*, trained to walk beside the shepherd as Odysseus walked by Agamemnon's side, and to be followed, trusted, pampered, and obeyed.

D W T.

### Drugs of Addiction

- (1) *A Review of the Effects of Alcohol on Man* Pp 300 (London: Victor Gollancz, Ltd., 1931) 8s 6d. net
- (2) *The Alcohol Habit and its Treatment* By Dr Walter E Masters Pp xvi+190 (London H K Lewis and Co, Ltd, 1931.) 6s net.
- (3) *Dangerous Drugs the World Fight against Illicit Traffic in Narcotics* By Arthur Woods Pp vii+123. (New Haven, Conn Yale University Press, London Oxford University Press 1931) 9s net

THESE three volumes deal with certain aspects of the medical and social problems presented by habit-forming drugs. (1) The first gives an account of the physiological and pathological effects of alcohol upon the human body and mind. It is the work of a number of different authors, and has been edited by a small private committee comprised of persons interested in the drink problem. Its aim appears to be to give a scientific account of the uses of alcohol as a food and a drug, and of the pathological results of alcoholism, chapters are devoted to the mental effects of alcohol, to its relationship to mental disorder, and to its possible racial effects. The book may be recommended as a balanced account of the subject, in which the legitimate uses of alcohol are carefully described and the effects of its abuse are neither minimised nor exaggerated.

(2) The second book is supplementary to the first. In its earlier chapters it covers much the same ground in brief, but the greater part of the book is devoted to the treatment of chronic alcoholism. Dr Masters considers that a real cure is impossible, the criteria of cure being that the desire for the



alcoholic euphoria is abolished and the capacity for moderate indulgence regained, without the least desire for an excess. On the other hand, a number of addicts can be converted into total abstainers and in this sense cured the rest relapse. The author includes a chapter on certain legal considerations of drunkenness.

(3) Drugs of addiction other than alcohol, morphine, cocaine, and their derivatives, are dealt with in the third book, and from an entirely different aspect. After a short account of the effects of these drugs upon the system, including the mental effects for which they are taken, the author turns to the sociological aspects of the question, including the traffic in narcotic drugs and the steps already taken under the auspices of the League of Nations to limit their manufacture and distribution. The book gives a highly interesting account of the tricks used by the traffickers in distributing the drugs; the real remedy appears to be limitation of manufacture to legitimate medical requirements, but the League has not yet persuaded all manufacturing countries to adopt vigorous measures of control. Perusal of this little book should increase the demand for firm action in those countries which have not yet adopted adequate limitation of manufacture or control of distribution.

### Short Reviews

*Penrose's Annual the Process Year Book and Review of the Graphic Arts* Vol 34, 1932. Edited by William Gamble. Pp xv+126+54+105 plates. (London Percy Lund, Humphries and Co, Ltd, 1932) 8s net.

"PENROSE'S ANNUAL" is always a happy hunting-ground to anyone interested in the printing of books and pictures. This year's volume is a rich collection of work of all kinds, much of it very beautiful. Perhaps the outstanding examples are those in photogravure, both monochrome and colour. We are by this time thoroughly accustomed to the fifty-year-old 'half-tone' process, and it is therefore interesting to find that even in this process advance is being made: the successful making of blocks for half-tone reproductions in colour has depended very much on the judgment and skill of the fine etcher. The recent introduction of a special colour chart and set of dot-size samples has, however, reduced the fine etcher's work almost to a certainty—judgment and experience are largely replaced by comparison with standard dots. The general trend in the printing industry is, indeed, strongly towards standardisation of method. A new development during 1931 has been the formation of a Printing Industries Research Association. Its work so far has apparently been mainly consultative, but experimental work has begun on several problems. S O R

No 3250, Vol 129]

*Molds, Yeasts and Actinomycetes a Handbook for Students of Bacteriology* By Prof A T Henrici. Pp x+296. (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1930) 17s 6d net.

As our knowledge increases, the part played by fungi as distinct from bacteria in the soil, in the spoilage of food, and in disease processes in animals and in man, is becoming more recognised. A book dealing in some detail with these organisms is therefore likely to be of considerable use for reference purposes. Sufficient information is given on the morphological side to enable the more important species to be identified, whilst the chemical aspect of their behaviour is adequately considered, as well as the industrial application when such is of moment.

This book is an American production, it is well arranged and printed in clear type, and particularly well illustrated. Ample references to the literature are given at the end of each chapter.

*Das Wasser in der Natur und im Dienste des Menschen* Von Dr Hans Heinze (Der Weg zur Natur) Pp xi+164. (Freiburg im B Herder und Co, G m b H, 1930) 3 60 gold marks.

To discuss in any detail the occurrence of water in its many natural appearances and in its human relationships as well, would be impossible in so small a book. Therefore its eleven short chapters deal in a popular and simple manner with the more striking characteristics and influences of rain—of seas, lakes, and rivers, of snow and ice. Plant life enters the story when the fall of the leaf in autumn exemplifies the effect of a shortened water-supply, and microscopic animal life is revealed as the marvellous content of water-drops, but here the illustrations are very crude. A third of the book deals with drinking water, mineral waters, and water as a source of power, and, in connexion with each, with the apparatus by which man has harnessed them for his own purposes.

*Applications of the Absolute Differential Calculus.* By Prof A J McConnell. Pp xii+318. (London, Glasgow and Bombay Blackie and Son, Ltd, 1931) 20s net.

THIS work fills a distinct gap in the mathematical student's library by giving an account of tensor methods in their application to the more elementary problems of geometry and physics. Of the four parts into which the book is divided, the first deals in a clear and simple manner with the fundamental ideas of tensor theory. In the second part these ideas are applied to algebraic geometry. The third part introduces the absolute differential calculus proper, the differentiation of tensors, and develops the application to differential geometry. In the fourth part the author deals with applications to dynamics, hydrodynamics, electricity, and elasticity. There is a large collection of examples which greatly enhances the value of the book to the student.

## Hydrogen Liquefaction Plant at the Royal Society Mond Laboratory

By Prof P KAPITZA, F.R.S., and Dr J D COCKCROFT

**I**N the Royal Society Mond Laboratory which is now under construction at Cambridge, in addition to the apparatus required for producing intense magnetic fields, a plant for cryogenic work will be installed. We have developed as a first instalment of this apparatus a hydrogen liquefier which differs from existing liquefiers in that it allows hydrogen of a lower degree of purity than the normal to be used for liquefaction. We propose in this article to give a brief description of the liquefaction apparatus, and later to publish a more complete account.

As is well known, the only method used at present for the liquefaction of hydrogen is essentially the same as that employed originally by Dewar in 1898, and is based on the Joule-Thomson effect combined with a thermal regenerator. In order to obtain a positive Joule-Thomson effect for hydrogen a preliminary cooling with liquid air is required. The principal difficulty encountered in liquefying hydrogen in large quantities is due to the impurities present in the gas, unless extremely pure hydrogen is used, these impurities solidify at the temperature of liquid hydrogen and block the tubes in the regenerator and stop the circulation of the gas. The seriousness of this effect can be shown from a numerical example. The purest commercial hydrogen available in Great Britain is 99.5 per cent pure, 3.9 cubic metres of gas are required to produce 5 litres of liquid hydrogen, and the impurities—chiefly air—when solidified have a volume of about nineteen cubic centimetres. Their deposition is thus quite sufficient to block the small bore tubes of the regenerator, and special precautions have to be taken to avoid this difficulty. In the method developed by Kamerlingh Onnes at Leyden, a preliminary purification of the hydrogen to a high degree of purity is carried out, and steps are taken to save the gas after it has been used for experiments. Another method introduced by Meissner is to make a special trap in the hydrogen circulation in such a way that in it the greater part of the impurities are condensed, the liquefaction is stopped at intervals to allow the trap to be warmed by a special electrical heater and emptied.

In our liquefier we have adopted a different principle which allows us to use the apparatus continuously even with commercial hydrogen. The method is as follows. Two hydrogen circuits are used in the liquefaction process, one circulation is similar to that used in ordinary liquefiers, but is completely closed, in it about 0.7 cubic metre of purified hydrogen is compressed to 160-170 atmospheres, and after preliminary cooling in liquid nitrogen at reduced pressure passes through a regenerator spiral and then expands to normal pressure, thereby cooling down a 'condenser' to liquid hydrogen temperature, after which it returns through the regenerator to the compressor. In the second circuit we use ordinary commercial

hydrogen, which is reduced to a pressure of 3 atmospheres by means of a reduction valve from cylinder. This hydrogen is cooled down to the temperature of liquid nitrogen and is then passed directly into an 'exchanger' cooled by the first circuit. Since the liquefaction temperature of hydrogen at 3 atmospheres pressure is a few degrees higher than at normal pressure, it liquefies in the exchanger. The whole of the cooling down process, from the temperature of liquid nitrogen to the temperature of liquid hydrogen, takes place in the exchanger, so that all the impurities condense here and do not have a chance of being deposited in the tubes. The solidified impurities are heavier than the liquid hydrogen and remain at the bottom of the exchanger, which is large enough to retain all the impurities solidified in the course of a run.

The scheme of the liquefier is shown diagrammatically in Fig 1, and a photograph of the liquefier in Fig 2. The hydrogen in the closed circulation enters at tube 1, passes through the regenerator spiral A, and enters the container B containing liquid nitrogen at reduced pressure, from which it passes through the second regenerator spiral D, and then through the expansion valve E to the condenser F, where it is partially liquefied. When the condenser F is about one-third full, the liquid hydrogen passes through tube 6 to a spiral which

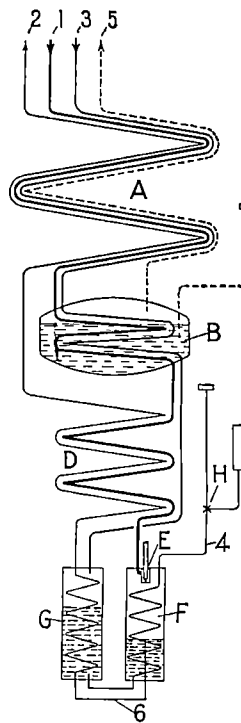


FIG 1

goes through the regenerator spirals D and A and passes back to the compressor through the outlet 2. The commercial hydrogen enters the tube 3 and passes only through the first regenerator circuit A, and the container B, and then passes directly into the exchanger G, where it meets the spiral cooled by the closed circulation and is liquefied at three atmospheres pressure. The exchanger G is continuously drained through the tube 4 passing through the condenser F as a spiral and leading to valve H, which controls the flow of liquid hydrogen into a Dewar receptacle. In passing through the spiral of condenser F, the liquid hydrogen is cooled through a few degrees from the temperature corresponding to liquefaction at three atmospheres pressure to the temperature of liquid hydrogen at atmospheric pressure. This prevents excessive evaporation when it is

drawn off into the Dewar receptacle. The exchanger *G* is filled with wire gauze which helps in the liquefaction. In the actual liquefier a double container is used for the liquid nitrogen. In one part the liquid nitrogen is evaporated at slightly reduced pressure and the evaporated gas passes up tube 5 of regenerator *A* and takes up sufficient heat to cool down the incoming hydrogen of the liquefaction circulation, in the other part the liquid nitrogen evaporates at a few centimetres pressure and passes away directly to the pump. (During a recent visit to Dr Simon's laboratory at Berlin, we have been informed that the same principle of

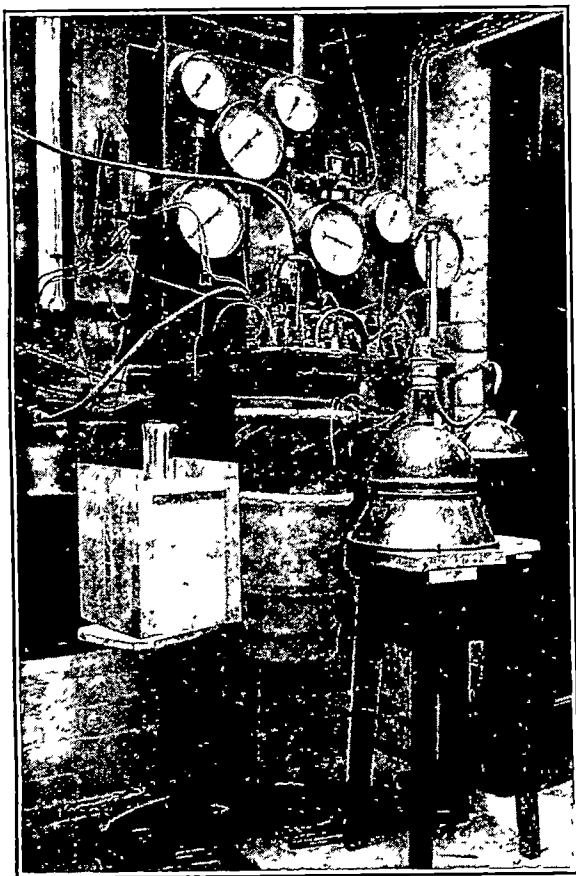


FIG 2

cooling hydrogen in two stages was used in his liquefier.)

The tubes used in the liquefier have a small cross-section and the gas is allowed to flow with high velocity. We find, as suggested by Meissner,<sup>1</sup> that the heat exchange can be calculated from Nusselt's formula.<sup>2</sup> From this formula it appeared that a good heat exchange could be obtained by using a high velocity of the gas, and this enabled us to reduce the length of the regenerator spirals very considerably. In our case the spiral *A* was about 2.5 metres long and the spiral *D* 5 metres. The high tensile strength of the copper-nickel alloy allows the heat capacity of the regenerator spiral to be considerably reduced. The whole apparatus is soldered into a copper vessel 26 cm in diameter

by 67 cm high, which is then evacuated. By the use of charcoal to absorb gases given off from the metal, a good vacuum can be maintained and a high degree of thermal insulation maintained without the use of glass Dewar vessels.

The new liquefier has the considerable advantage that the rate of liquefaction can be measured continuously by a flow meter placed before the inlet of tube 3. The flow meter will also indicate the moment when the gas begins to condense. An electrical flow meter is used. The hydrogen is passed through a thin-walled copper-nickel tube 20 cm long, which is heated in the middle by a platinum wire spiral. The cooling of this spiral depends on the rate of flow of hydrogen through the tube and is measured by its change of resistance. The spiral is made in two parts which form the two opposite arms of a Wheatstone bridge, the other two arms are also made of platinum, and are wound on the thick copper main tube, and thus are kept at the temperature of the inlet hydrogen. The apparatus is calibrated by separate experiments.

The liquefier has proved to be as efficient as ordinary existing liquefiers. The heat exchange is good, and the temperature of the return hydrogen and nitrogen at exit is only 10° below the temperature of the inlet hydrogen. 4-5 litres of liquid nitrogen are used for the initial cooling, and liquefaction starts 40-50 minutes after the beginning of the preliminary cooling. The liquefaction rate is 4 litres an hour, of which about twenty per cent is lost when the hydrogen is drawn off. The liquid nitrogen consumption is about 1.3 litres per net litre of liquid hydrogen. We normally produce 6 litres of liquid hydrogen in a single run, using commercial hydrogen, and have not up to the present had a single stoppage due to blocked tubes. The liquefier was made in our workshop by the laboratory mechanic, Mr. H. E. Pearson.

The compressor used for the work is a compact, triple stage, high speed (600 r.p.m.) machine which was specially built for us by Messrs Reavell and Company. The detailed design was worked out by Mr. J. Hendry. Special care was taken to ensure complete freedom from leakage, the space below the cylinders is connected to the compressor suction, and the piston rods are surrounded by oil-sealed glands which are fitted with leakage indicators. At full speed the compressor capacity is 25 cubic metres of free gas per hour, at present we are using it at reduced speeds giving a delivery of 16 cubic metres per hour.

The problem of storage of liquid hydrogen has been dealt with on new lines. It is well known that owing to the small latent heat it is difficult to store liquid hydrogen in an ordinary Dewar flask for more than a day. As described by Meissner,<sup>3</sup> the best containers, of a capacity of 6 litres, evaporate at the rate of 15 gm (200 c.c.) of hydrogen an hour, these containers have a specially good vacuum and silvered surfaces to prevent radiation losses, which are the most important source of loss of cold. In order to diminish these radiation losses further, we have worked out a design for a Dewar flask which has all the advantages of the

method of keeping the liquid hydrogen container immersed in liquid air, without the disadvantages and technical difficulties which occur if this method is used on a large scale. A drawing of the flask is shown in Fig 3. It consists of a twin flask, flask

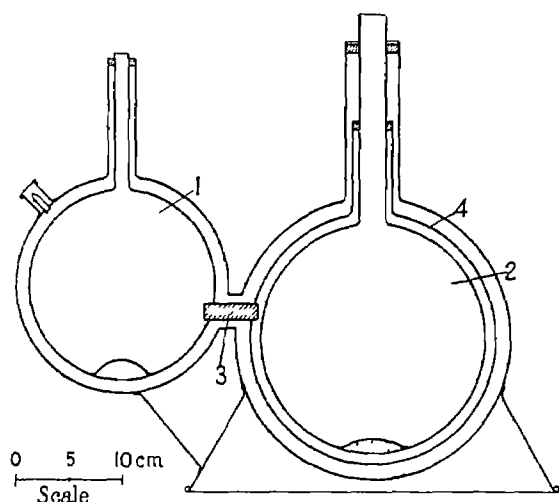


FIG 3

1 contains liquid air, and flask 2 liquid hydrogen. The inside of flask 1 is connected by means of a copper rod 3 to a copper shield 4 which surrounds the container of flask 2. The liquid air cools the shield 4 by thermal conductivity, and the radiation losses from the liquid hydrogen are considerably reduced. The hydrogen flask has a capacity of 5 litres and the liquid air flask holds 2 litres. The

evaporation of hydrogen is about 2.5 gm. an hour, which is about seven times smaller than for ordinary flasks, and enables the liquid hydrogen not required for immediate use to remain in the flask for five days. The consumption of liquid air is about 1.7 litres per day. A picture of the flask will be seen in Fig 2 standing beside the liquefier.

Another flask is now being constructed in which the radiation will be further reduced by silvering the inner surfaces, thereby increasing the efficiency of the flask still further. The flask was manufactured for us by Messrs Siebe Gorman and Co., Ltd.

The remaining equipment of the Laboratory is on the usual lines, and all the known precautions against explosion are employed, flame-proof mining type motors being used for the compressor drive and all open switchgear placed in a separate room. Besides the usual precautions we have introduced one more, which consists of a standard alarm lamp as used for showing the presence of coal gas in mines. This indicator is manufactured by Messrs The W. R. Patents, Ltd. Should a leak occur, and the concentration of hydrogen in the room reach a value of more than one per cent, the lamp operates a relay which automatically stops the machines, and throws the windows open at the bottom and the top of the rooms where the liquefier is in operation, thus providing a complete air circulation.

We were enabled to construct this plant by a special grant made by the Department of Scientific and Industrial Research.

- <sup>1</sup> "Handbuch der Physik", vol. 11, p. 295
- <sup>2</sup> Groeber, "Wärmeübertragung", p. 84
- <sup>3</sup> Z. Instrumentenkunde, 50, 121, 1930

### Diagnosis of Smallpox \*

FOR adequate control of infectious disease, early and accurate diagnosis is of great importance, but clinical differentiation is not always easy in the early stages. Thus smallpox, even of the severe type, may be mistaken for chickenpox. Some years ago M. H. Gordon described a 'flocculation' test for smallpox, which was later investigated by W. L. Burgess, J. Craigie, and W. J. Tulloch. The last two authors have now extended and amplified the earlier observations. The technique of the test is, in brief, as follows: crusts obtained from the pocks are dried and finely powdered, the powder is extracted with ether and then with saline for some hours, the mixture is frozen, thawed, and centrifuged to remove particulate matter. Series of dilutions of the extract are made in saline. To one antiovaccinia serum is added, to the other normal rabbit serum, and both sets are incubated for about 18 hours at 45°-55° C. Flocculation occurs in the first series at high dilutions of the extract if the crusts were obtained from a case of smallpox, but is not seen in the second series to which normal rabbit serum was added.

The authors carried out an investigation of every step in the test so as to obtain the best conditions

thus it was found that more satisfactory results were obtained when the concentration of antiserum was kept constant and that of the antigen (crust extract) varied than when the converse system was employed. For the extraction of the crusts, 0.9 per cent sodium chloride solution was better than weaker concentrations and much more satisfactory than a phosphate buffer solution. In the latter the reaction shifted towards the acid side, whereas that of the saline extracts is remarkably stable. It is essential to carry out the flocculation test at about pH 7. At pH 6 or 8 non-specific sedimentation is liable to occur. The preliminary extraction with ether removes certain substances which may obscure the test and also reduces the tendency to anomalous flocculation. It has been found further that the flocculable substance is fairly intimately connected with the euglobulin fraction of extracts although it can be to some extent separated therefrom when the flocculable substance has been destroyed infectivity has also disappeared, but the latter can be markedly reduced without affecting the former. The purified euglobulin fraction is not very stable to heat but is fairly stable to low concentrations of phenol. It is possible to detect by the flocculation test so little as 0.0000005 gm. of purified flocculable material.

The flocculation test is positive in smallpox

\* Medical Research Council Special Report Series No. 156. Further Investigations on the Variola-Vaccinia Flocculation Reaction. By J. Craigie and W. J. Tulloch. Pp. 129. (London: H.M. Stationery Office, 1931.) 3s. net.

(mild or confluent), dermal vaccinia, neurovaccinia, or generalised vaccinia of the rabbit. Out of 195 tests on human material only three (cases of variola minor) gave apparently erroneous results. All crusts from cases of chickenpox were negative. The test is therefore specific and indicates the identity of the infecting virus of smallpox with that of vaccinia (or cowpox, the attenuated virus which is used to develop immunity to smallpox in human beings by 'vaccination'). These results also show that the secondarily infecting bacteria present in dermal material have no influence on the reaction, this conclusion was confirmed by further direct experiments. Thus it was found that crust-extracts removed the flocculating property from anti-vaccinia serum, but failed to remove the staphylococcal agglutinating bodies from antistaphylococcal serum, and that absorption with suspensions of secondarily infecting bacteria had no effect on the flocculating properties of anti-vaccinia serum although such absorption rendered inert the anti-sera specific to the secondarily infecting organisms.

An antiserum such as is used for the flocculation test appears to exert a specific antibody action on the virus *in vitro*. After four hours incubation at 37° C of a mixture of serum and virus the latter is inactivated or destroyed, since no lesion is produced on dermal inoculation. Destruction is theoretically unlikely and probably does not actually occur since infection may be produced if inoculation is made into the rabbit's testes.

On the other hand, evidence was obtained that passive immunity to vaccinia could be produced in rabbits and guinea-pigs by the injection of anti-vaccinia serum possessing flocculating properties. The immunity of the animals was tested by dermal, testicular, and intravenous inoculation of virus; the results did not depend on the serum or strain of virus used.

As a natural sequel to the above results, attempts were made to produce immunity by the use of virus sensitised with antiserum. It was found that such a mixture, although failing to 'take' on dermal inoculation, produced, on subcutaneous injection into rabbits, a very high degree of immunity. The importance of this observation lies in the fact that it may be possible to produce immunity in human beings by this method without the risk, small though it is, of the development of the sequelæ, such as vaccinal encephalitis, which occasionally follow ordinary 'vaccination'. The theoretical objection to the use of sensitised virus is that although the antiserum may control the infection at the site of injection, it may be powerless to do so if the virus is disseminated. The authors are carrying out further investigations on this point. In any event, the results of the experiments on the production of passive immunity suggest that it might be possible to immunise smallpox contacts so that the disease would be aborted even in circumstances when vaccination might fail to prevent infection.

### Obituary

MR LOUIS BRENNAN, C B

BY the death of Louis Brennan on Jan 17, at Montreux, Switzerland, Great Britain loses an inventor whose name was once very widely known. Born at Castlebar, Ireland, on Jan 28, 1852, Brennan at an early age went to Australia, and it was while working as a watchmaker in Melbourne that he conceived the idea for a torpedo which could be fired and controlled from a fixed position.

Assisted by a member of the staff of the University of Melbourne, towards the end of the seventies of last century Brennan succeeded in arousing the interest of Government officials, and in 1880 the Admiralty appointed a committee of naval officers serving on the Australian station to report on the torpedo. Their report being favourable, Brennan was brought to England, and as the torpedo was considered very suitable for the defence of creeks and harbours, the matter was taken up by the War Office, Brennan being attached to the Royal Engineers at Chatham, and a torpedo factory being built at Gillingham. Brennan was at first given a retaining fee of £5000 and a salary of £2000. He superintended the factory for many years, and from 1896 until 1907 was retained as consulting engineer.

Luke Whitehead's automobile torpedo, Brennan's machine was fish-shaped and had fins, horizontal and vertical rudders, hydrostatic depth control, and double propellers, but it was driven and con-

trolled by two wires running over drums driven by a steam engine in the firing station and connected with other drums in the body of the torpedo.

At Gillingham, Brennan began his work on the monorail locomotive with gyroscopic stabilisers. His model, now in the Science Museum, South Kensington, was described in the technical press in 1907, and a public trial of his car took place at Gillingham on Nov 10, 1909. The car was 40 ft long, 10 ft wide, and 13 ft high, and had a wheel base of 20 ft and a weight of 20 tons. It ran on a single rail track, which included a circular path 200 yards round, and successfully carried a party of 40 persons. It was fitted with two petrol engines driving electric generators supplying current to the driving motors, and to two large gyroscopes which preserved the balance of the car in all circumstances. Each gyroscope had a wheel weighing three-quarters of a ton, revolving at 3000 r.p.m. in a casing from which the air was exhausted. On the day of trial, owing to one of the generators being out of action, a speed of only 7 miles an hour was attained, but the designed full speed was 35 miles an hour. Brennan himself envisaged a monorail car 150 ft long and 25 ft wide travelling at about twice the speed of existing railway trains, but his invention did not lead to any development.

During the War, Brennan served with the Ministry of Munitions and later with the Air Ministry, and

experimented with a helicopter, but much of his work was of a confidential nature. He received the honour of C B in 1892, in 1906 was made a honorary member of the Royal Engineers' Institute, and in 1922 a foundation member of the National Academy of Ireland

#### MR C J MERFIELD

THE tragic death of Mr Merfield as the result of a motor accident occurred on Jan 23, 1931, but it did not become known in England until later. He was a very zealous and active worker, and undertook a large number of extensive astronomical computations. In his early career he was a surveying engineer, but even then he computed the orbits of comets in his spare time, the orbits of comets 1897 I, 1901 I, etc., were published in *Astronomische Nachrichten*. The last was a very bright southern comet, Mr Merfield's elements, which indicate a period of 39,000 years, are accepted as definitive.

A few years later, Mr Merfield joined the staff of the Sydney Observatory, he moved to Melbourne Observatory in 1908, and became chief assistant there in 1919, a position which he held until his death. He continued his work on comets, deducing an accurate orbit of Halley's comet from the early observations, and tracing the perturbations of the Pons-Winnecke comet for a long period, including its near approach to the earth in 1927. In his earlier years he had studied under Dr R T A Innes, it was doubtless at the suggestion of the latter that he performed the laborious task of computing the secular perturbations of Eros, Ceres, and Iris, these were published in *Astronomische Nachrichten* in 1907 and 1909.

Mr Merfield was also interested in eclipses, and computed their circumstances in Australia and the neighbourhood, he observed the total solar eclipses of 1901, 1910, and 1911. His son, Mr

Z A Merfield, is the Australian representative on the Solar Eclipse Committee of the International Astronomical Union. We are indebted for many of the above details to Mr J A Moroney, president of the Astronomical Society of Victoria, of which Mr Merfield was the first president on its formation in 1922.

PROF HOLLAND CROMPTON, formerly professor of organic chemistry at Bedford College, London, who died on Dec 22, 1931, was born in Preston, Lancashire, on April 30, 1866. He attended school in Stuttgart and later studied chemistry under Prof H E Armstrong at the City and Guilds Institute. In 1888 he was appointed lecturer and head of the Department of Chemistry at Bedford College, London, in succession to Spencer U Pickering. He held this post until 1919, when the department was divided, and from that date until his retirement in 1927, on account of ill-health, he was head of the Department of Organic Chemistry. Crompton never enjoyed robust health, and in his later years it became steadily worse. He will be remembered by both organic and physical chemists on account of his work on acenaphthene, atomic energy and the specific heat of gases, molecular association and molecular magnitudes, osmotic pressure and the electrolytic dissociation theory.

WE regret to announce the following deaths

Prof Clarence L E Moore, professor of mathematics in the Massachusetts Institute of Technology, Cambridge, Mass., who devoted particular attention to the geometry of the sphere and circle in space, on Dec 5, aged fifty-five years.

Prof R Stenhouse Williams, first director of the National Institute for Research in Dairying, Shinfield, Reading, and research professor in dairy bacteriology in the University of Reading, on Feb 2, aged sixty years.

### News and Views

#### Determinism Defined

SIR ARTHUR EDDINGTON's characteristically fascinating address on "The Decline of Determinism", which we publish as our Supplement this week, will be welcomed as a clear, unequivocal statement, by a leading authority, on a question which, even among the many revolutionary aspects of the new physics, holds a pre-eminent place for importance and interest. Such a statement is the more necessary because of the almost universal tendency for discussions of determinism to be concerned at bottom with words rather than ideas, and Sir Arthur has quite properly begun by stating definitely what he means by the determinism which he holds has declined. His thorough analysis leaves little room for disagreement, but many will wonder whether he has not achieved a Pyrrhic victory by conceding to the determinist the substance of his doctrine and destroying only the shadow. "The rejection of determinism is in no sense an abdication of scientific method", and "indeter-

ministic or secondary law . . . can be used for predicting the future as satisfactorily as primary law". In other words, Sir Arthur does not allow that the first Morning of Creation wrote what the last Dawn of Reckoning shall read, but he allows that it might have read what the last Dawn shall write. Even the most perfervid determinist will scarcely ask more. Furthermore, he acknowledges that he does not know whether Dirac, whose book "goes as deeply as anyone has yet penetrated into the fundamental structure of the physical universe", is a determinist or not. It would seem, therefore, that the determinism in question cannot be of much importance even in physics.

#### Physical Inference and Prediction

APPARENTLY, however, in spite of the unqualified statement concerning prediction quoted above, Sir Arthur denies that we can predict the behaviour of electrons more certainly than that of horses, and the importance, to all but the physicist, of the "decline



of determinism " therefore depends on the recognition of electrons as bodies co-equal with ordinary physical objects. To establish this he claims that since physical objects, as well as electrons and such particles, are all 'inferences', they differ only in degree and not in kind. We must not, however, be deceived by words. Objects which we see and handle may be, as he says, as inferential as an undiscovered planet inferred from irregularities in the motion of Uranus, but the inferences are of different kinds, otherwise, why, when a planet was seen in a different position from that inferred from the irregularities, was it *without question* preferred to the 'undiscovered' inferential planet? There was not even an instinctive estimate of the 'degree' of validity to be attributed to the two 'inferences'. Unless Sir Arthur assigns to "direct observation" a status essentially different from that of rational deduction, it is difficult to see how his position can be "in no sense an abdication of scientific method". All this, however, does not affect determinism in relation to physical objects, and it is to be hoped that Sir Arthur's plain statement will do much to remove the widespread delusion that modern physics has revealed a universe of unrestrained caprice.

#### Centenary of Octave Chanute

ON Feb. 18 occurs the centenary of the birth of the distinguished American engineer Octave Chanute, who by his experiments on gliding made in his later years, and by his writings on flight, gained for himself a place among the chief pioneers of aviation. Born in Paris on Feb. 18, 1832, he was the son of a professor of history who in 1838 removed to the United States to become a vice-president of the Jefferson College in Louisiana. There and in New York young Chanute attended school and, in his own words, became thoroughly Americanised. Leaving school at the age of seventeen, he entered the service of the Hudson River Railroad Company, and during the next four years gained considerable engineering experience. He next spent ten years on various railroads farther west, and from 1863 until 1867 was chief engineer of the Chicago and Alton Railroad. In 1868 he built the first bridge over the Missouri at Kansas City, in 1873 became chief engineer of the Erie Railroad, and about ten years later established himself as a consulting engineer in Kansas. He had already served on the commission of engineers which led to the building of the elevated railways of New York, and at Kansas he was responsible for the construction of the Sibley Bridge over the Missouri, and for the Mississippi Bridge at Fort Madison, Indiana. He retired to Chicago in 1889 after some forty years' work, much of which had contributed to making the railway system of the United States the most extensive in the world.

CHANUTE's interest in flight was first aroused in 1874, but it was not until he was nearly sixty years of age that he was able to devote himself wholeheartedly to the study of the subject. In 1891 he published his first work, "Aerial Navigation", and this was followed in 1894 by his "Progress

in Flying Machines", a work of great historical value. He had carefully examined the results of the experiments made by Otto Lilienthal in Germany, and just before that pioneer's death in 1896 had secured a Lilienthal glider and had begun his own experiments on the 90 ft sand-hills in Dune Park, near Lake Michigan. Finding the Lilienthal machine unsafe and treacherous, Chanute built a glider with five superimposed planes, which was afterwards altered to a quadruplane and then to a triplane. From these was evolved "the famous Chanute biplane of novel and exquisite design". One important feature introduced by Chanute was the means of moving the wings in a fore and aft direction to maintain balance, thus obviating the necessity for violent body movements. The experiments begun in June 1896 were continued until September, but after then were never resumed. An account of them was given in a paper published in the *Journal of the Society of Western Engineers* in 1897. While abandoning experiments, Chanute, although then sixty-four years of age, retained his enthusiasm for everything connected with flight, assisted and encouraged Wilbur and Orville Wright, and when an old man wrote his "Recent Progress in Aviation". He died at Chicago on Nov. 23, 1910, at the age of seventy-eight. Chanute possessed the truly scientific spirit, and was an acute observer as well as a gifted inventor. Courageous and generous, his character caused him to be both respected and honoured.

#### The Earthquake in Cuba

ON Feb. 3 a series of destructive earthquakes, beginning at 2.40 A.M., ruined about one-third of the city of Santiago, at the east end of Cuba, including the cathedral and many important buildings. The number of persons killed is reported as twelve, and the number of wounded as about three hundred. The earthquake was recorded at Kew Observatory as a disturbance of moderate intensity. The first impulses arrived at 6h. 26m. 45s. A.M. (G.M.T.), and the earthquake must have occurred at 6h. 16m. The neighbourhood of Santiago has long been known as one of the most active earthquake centres in the West Indies. The city was founded in 1514, and since then there have been great destructive earthquakes in 1624, 1678, 1766 (the greatest of all Cuban earthquakes), and 1852. Though the full extent of the damage is not yet known, the recent earthquake was probably of the second order of intensity among destructive earthquakes. The Santiago earthquakes are chiefly interesting owing to the position of their centres along a well-known dislocation, nearly 1250 miles long, that skirts the southern coast of the east end of the island and forms the northern boundary of the Bartlett Trough, a depression that in one part reaches a depth of 3506 fathoms, or about four miles.

#### An Ancient Mexican Tomb

A VALUABLE addition to our knowledge of a little-known culture of ancient Mexico, that of the Mixtec, is promised by a recent find of which news has reached New York. In a dispatch from the *Times'* correspondent which appears in the issue of Jan. 20,

it is stated that information has been received that treasure in gold and precious stones "worth millions" has been discovered in a sealed tomb in the course of excavation, under the direction of Don Alfonso Caso, at Monte Alban, near Oaxaca. The bodies of ten Mixtec caciques were found buried under a heap of cups, urns, vases, and jars of jade, onyx, and crystal, together with personal ornaments and utensils of gold richly inlaid with turquoise. The skulls of the chiefs were encrusted with turquoise, and with them was a finely wrought mask of gold. The disorder of the funerary offerings suggests haste, and this might have been due to the fact that the interment lies in the country of the Zapotec, with whom the Mixtec, notwithstanding their probable affinity, were frequently at war.

THE richness of the funerary offerings found at Monte Alban is fully in accord with the account given by Balboa, an early writer on the inhabitants of Mexico, of an interment in a cave—the usual type of burial chamber among the Mixtec—situated at Chalcotonga, supposed to be the gate of Paradise, in which the dead were laid out in rich garments and a number of small idols of gold, stone, and wood were placed in niches in the walls of the cave. Primary interments such as the recent discovery are supposed to have been confined to persons of high rank, the lower orders being placed in the ground for a time and their bones then collected and placed in a vase for deposit in a cave. It is suggested that the date of the burial is the fifteenth or early sixteenth century. Notwithstanding the scanty details, it is evident that this is the most imposing discovery of relics of the pre-Columbian culture of Mexico yet made. Its interest is considerably enhanced by the fact that so little relating to the Mixtec, who may in part have been of pre-Aztec strain, had been discovered previously.

#### Electrical Measuring Instruments

A SPECIAL exhibition of electrical measuring instruments opens at the Science Museum, South Kensington, on Feb. 13, and will remain on view until the middle of May. The exhibition illustrates the evolution of electrical measuring instruments, from the discovery of the fundamental principles on which they are based, up to the present day, and is substantially the same as the exhibition arranged by the British Electrical and Allied Manufacturers' Association and shown on the occasion of the Faraday Centenary Exhibition at the Albert Hall in September last. With the view of interesting the non-technical public, a series of simple demonstration experiments has been arranged to illustrate the various fundamental principles and their application to electrical measurement. Demonstrations will be given daily, the apparatus in some cases being a replica of that used by the original discoverer of the principle. The exhibition, which comprises about 250 exhibits, includes many original instruments, such as Kelvin's reflecting galvanometer, a resistance coil used by Wheatstone, Joule's current balance, and the coil with which Maxwell determined the ohm. Among the interesting replicas are those of Ørsted's Compass, with which the magnetic effect

of an electric current was first demonstrated, Ampère's electrodynamic apparatus, the apparatus with which Ohm discovered 'Ohm's Law', and Sturgeon's electromagnetic engine, which was the first machine to embody a commutator.

#### Weights and Linear Measures

IN addition, a small exhibition of weighing and linear measuring instruments will be on view in the Main Entrance Hall of the Science Museum from February until May. The exhibition illustrates briefly, by objects and photographic transparencies, progress in metrology since early times. In the very limited space available, only one form of balance has been selected for illustration—the precision or equal-armed balance; similarly, only standard scales and micrometer development have been shown in the linear section. The exhibits include, however, the principal British Exchequer standard weights and linear measures from the time of Henry VII (1485), excepting, of course, the current national standards. This collection, hitherto in charge of the Standards Department of the Board of Trade, has now been transferred to the Science Museum.

#### World's Commercial Electricity Supply

THANKS to the activities of the World Power Conference, data in connexion with the supply of electricity throughout the world are now available. It appears that in 1930 the total capacity of the electric generators used was 114 million kilowatts and that the electric units (kw.h.) generated were 304,000 million. The electricity supply industry represents the largest public utility service in the world, and the capital invested in it almost equals the capital invested in railways. If we take as our unit a 1000 million kw.h., the total output of electricity in North America was 139, of which the United States generated 121, about two-fifths of the total world output. Germany comes next with an output of 29.4, Canada with 17.8, Great Britain with 17.2, Japan with 16.3, France with 15.9, and Italy with 10.8. Owing to the world-wide industrial depression, there is a distinct slowing down of the rate of development during this period as compared with the preceding year. This is mainly due to slackness in the industrialised countries of western Europe and North America. Statistics in connexion with the capacity of the dynamos installed raise the question of whether the generating equipment throughout the world has outrun the demands made on it. It is a little difficult to answer this question, but we think that when industry revives there will be an immediate demand for more electrical machines.

#### Northumbrian Coals

THE Fuel Research Board has just issued Paper No. 21 of the Physical and Chemical Survey of the National Coal Resources, being a report on the Yard Seam of Northumberland. The report is a very full one, and appears to be very carefully done. There is only one point to which attention may be directed. In places there is a narrow band of dirty coal at the top of the seam known locally as 'top brat', which the report states is "sometimes known as 'roof coal'".

or 'ramble'." From the wording of the report the reader might suppose that the term 'ramble' is confined to this particular coal, but as a matter of fact it is a generic term for any thin bed of shaly matter that comes down when the underlying coal is worked. Thus in the "Glossary of Terms used in the Coal Trade of Northumberland and Durham", by G. C. Greenwell, the first edition, published in 1849, defines ramble as "A thin stratum of shale, often found lying immediately above the seam of coal. It falls down, and, getting mixed with the coals, causes some trouble to the hewer, in getting it separated and cast back." Seeing that this brat, although described as dirty coal, is stated to have contained in one place as much as 69 per cent of ash, whereas one of the bands of shale contains only 46 per cent, it is obvious that this band might fairly come within Greenwell's definition. Perhaps the most interesting statement in the report is that the authors find "the coking properties of the seam to be weak, but not non-existent", seeing that Northumbrian coals are generally supposed to be non-coking, this statement is a very important one, and leads to the inference that the Yard Seam shales may be useful for blending with more strongly coking coals in order to produce a good metallurgical coke.

#### Cormorant Fishing in China

It is sometimes said that since the neolithic age man has made no progress in domesticating wild creatures, except for the improvements made in the breeds of animals domesticated at that time. But the domestication of the cormorant in China belongs to a much more recent period. The story has been worked out in detail by Berthold Laufer of the Field Museum of Natural History, Chicago (*Field Museum Publication* 300, Anthropological Series, vol. 18, 1931). The earliest mention of the use of trained cormorants for fishing refers to Japan and dates from about A.D. 607, when, presumably, such use was unknown in China. Yet the trained cormorants of Japan are scarcely more domesticated than the English cormorants which James I. delighted to watch, and for whom he appointed a 'master of the royal cormorants'. In China the birds are completely domesticated, being bred and reared in captivity, so that they become perfectly submissive to their masters, whose commands they understand, and whom they obey with the readiness and docility of a dog. Characteristic of their domestication is the appearance amongst them of colour varieties, particularly of albinistic and pied individuals. Their eggs are always hatched by domestic fowls and not by the cormorant mother, and the young are fed on special foods until the period of their training for fishing begins, and this lasts for seven or eight months.

#### Investigations of Isotopes in 1931

In the *Berichte der deutschen chemischen Gesellschaft* for January 1932 will be found a report by Prof. O. Hahn upon the progress made during the year 1931 in the investigation of isotopic forms of the elements. In a footnote it is explained that the German Chemical Society has arranged for the continuation of such reports upon this subject until

such time as an international commission shall have been set up for the purpose. The present report supplements the last biennial report, published in London nearly a year ago in the *Annual Reports of the Chemical Society*. After referring to the new determination by Mecke and Childs of the relative proportions in oxygen of its isotopes, and to the desirability of retaining oxygen for the present as the standard in estimating atomic weights in spite of its complex nature, the author of the report reviews the latest developments obtained by means of the mass-spectrograph and of band spectra. Two useful tables are appended, containing respectively a list of sixty-three elements, which have hitherto been examined, together with their isotopes, and a list of no fewer than thirty-six pairs of isobars of non-radioactive elements.

#### American Geophysical Union

THE *Transactions of the American Geophysical Union* (published by the National Research Council) at its twelfth annual meeting, on April 30–May 1, 1931, appeared in June. This promptness, due to the able organisation of the secretary, Dr. J. A. Fleming, and to the use of direct reproduction from typescript, much enhances the value of the report. From its 227 pages geophysicists elsewhere can obtain a rapid and comprehensive view of the large amount of work in this field now being done in the United States and, to a certain extent, in Canada and Mexico. The general assembly was mainly devoted to a symposium on time-signals, most of the work of the meeting is done in the seven sectional meetings. In seismology, the papers related chiefly to the development of new or improved instruments, in meteorology, to the work of the International Polar Year, in terrestrial magnetism and electricity, including radio work, the papers were very numerous and covered a wide range of subjects, in oceanography, the reports of many institutions on their past work were the main subject of discussion, hydrology forms a separate section, and had a long and varied programme, and there were a few papers on volcanology.

#### Apparatus for Absorption Spectrophotometry

MESSRS. Adam Hilger, Ltd., have published an interesting booklet dealing with the outfits they supply for absorption spectrophotometry in the visible and ultra-violet regions. The most important new instrument which is described is a form of ultra-violet spectrophotometer, working on the principle of the variation of the aperture of the beam, for which the name Spekker has been registered. This has been designed primarily for use with Hilger's medium quartz spectrographs, but may be attached to any similar instrument of sufficiently great aperture. Judging by the description of the instrument, and by a specimen set of absorption photographs for benzene in hexane, this should be both highly convenient to use and accurate in the results it yields. A photoelectric outfit is also described, although not very enthusiastically, the opinion being expressed that the use of a photoelectric cell in place of the eye or a photographic record diminishes the likelihood of a number of important sources of error being recognised, so that

there is a liability that copious and apparently highly accurate results may be amassed which are actually unreliable. Other devices listed include Bay and Steiner's hydrogen discharge tubes for providing continuous ultra-violet sources of light, and also a micrometer liquid cell for studying the absorption of thin layers of liquid.

#### Biology in Shakespeare

It would be indeed a difficult problem to conceive of any new point of view from which to study Shakespeare's works. In the *Scientific Monthly* for January, Prof Fraser-Harris has made a study of the world's greatest poet and dramatist from the point of view of biology, and though the topic is not a new one—there is a public garden in Manchester where nearly all the plants, wild and cultivated, mentioned in Shakespeare are grown, and references given—the method is new, in that Prof Fraser-Harris has aimed, not at giving a catalogue of plants and animals, but at considering a few allusions which are of distinctly physiological or psychological interest. For example, Prof Fraser-Harris claims four participating factors in sleep—chemical, vascular, sensory, and ideational, and Shakespeare recognises two of these in the famous soliloquy of the king in "Henry IV". Although Shakespeare was a contemporary of Harvey, there is no reference in his works to blood circulation, and though one might express surprise at this, Prof Fraser-Harris gives sufficient argument why Shakespeare was ignorant of the then new discovery. These are only two examples of how Shakespearean lines embody deep biological truths, many more, with the appropriate quotations and commentaries, are given by Prof Fraser-Harris in his interesting article.

#### Veterinary Research in South Africa

WE have received the seventeenth report of the Director (Prof P. J. du Toit) of Veterinary Services and Animal Industry, Onderstepoort, Pretoria (Union of S Africa Dep of Agriculture. The Government Printer, Pretoria, 1931. 10s each part). It is issued in two parts of about 425 pages each, is well produced and fully illustrated, and contains a mass of valuable material dealing with all branches of veterinary research and animal industry. Part 1 contains the parasitological matter, part 2 physiological, pathological, and industrial subjects and metabolism. Of general interest may be mentioned papers on a new and cheap method of preparing pure cystine from wool, and giving a high yield, by J. G. Louw, the good effects of sulphur on merino sheep in doses of 5 gm from once to six times weekly, the general condition of the animals, weight, and wool yield being strikingly improved, by D. G. Steyn, and the improved quality of bacon obtained by including barley meal in the pig's ration, by D. J. Schulte and C. A. Murray.

#### British Lenses

WE learn from Messrs Taylor, Taylor and Hobson, Ltd, that they have recently received a contract for no less than 350,000 lenses, totalling more than half a million glasses, for inexpensive hand cameras

Messrs Taylor, Taylor and Hobson produce costly Cooke lenses used in some of the world's leading observatories for stellar photography, and also highly corrected Cooke lenses of large aperture for the exacting requirements of the principal cinema studios throughout Britain and the United States. It is the high degree of precision demanded by these more expensive products that has enabled the firm to design and make machinery capable of producing inexpensive lenses in such quantities and in competition with such low Continental prices as those for which the above contract has been awarded.

#### Eskimo Settlement in Alaska

AN expedition of the University of Pennsylvania Museum, of which Miss Frederica de Laguna is the leader, working in Alaska during the past season, reports the discovery, according to Science Service, of a prehistoric Eskimo settlement at Cook's Inlet. This area is at present inhabited by Indians, and the settlement would appear to represent the most southerly extension of Eskimo culture known. Shell heaps on the shore, some of them ten to fourteen feet in height, have been investigated. Among the relics were a number of personal ornaments, including lip plugs, beads, an ivory pendant, a carved ivory head, and a nose-pin. The objects of domestic use included a lamp, a needle-case and needles, and an ivory catch for a box. One of the most interesting relics was a mirror of slate, of which the surface showed the reflection on being damped.

#### Esperanto in Scientific Literature

REFERRING to the recent correspondence in *NATURE* on Esperanto in scientific literature, Prof W. E. Collinson, professor of German and John Buchanan, lecturer in Esperanto in the University of Liverpool, has written stating that the fullest and most extensively documented account of such writings is Section 86 of Dr Eugen Wuster's "Internationale Sprachnormung in der Technik—besonders in der Elektrotechnik" (published with the support of the Akademie des Bauwesens, VDI-Verlag, Berlin, 1931). This work deals with the problem of the international standardisation of technical nomenclature in all its aspects, and shows the wide range of topics in which work has already appeared in Esperanto, namely, biochemistry, strength of materials, inorganic and organic chemistry, telephony and wireless, bacteriology, analytical geometry, etc.

#### Postponement of an International Congress

WE learn from the General Secretary, Prof. E. Moles, San Barnado 49, Madrid, that at a meeting of the Bureau of the International Union of Chemistry and the organising committee of the Ninth International Congress of Pure and Applied Chemistry held recently, it was decided to postpone the Congress indefinitely. The Congress was to have been at Madrid on April 3-10 this year, but it was felt that the present world-wide economic depression would limit seriously the usefulness of such a gathering. When conditions improve it is hoped to hold the Congress as originally arranged at Madrid.

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## The Decline of Determinism \*

By SIR ARTHUR EDDINGTON, F R S

**D**ETERMINISM has faded out of theoretical physics. Its exit has been commented on in various ways. Some writers are incredulous, and cannot be persuaded that determinism has really been eliminated. Some think that it is only a domestic change in physics, having no reactions on general philosophic thought. Some imagine that it is a justification for miracles. Some decide cynically to wait and see if determinism fades in again.

The rejection of determinism is in no sense an abdication of scientific method, indeed it has increased the power and precision of the mathematical analysis of observed phenomena. On the other hand, I cannot agree with those who belittle the general philosophical significance of the change. The withdrawal of physical science from an attitude it has adopted consistently for more than two hundred years is not to be treated lightly, and it involves a reconsideration of our views with regard to one of the perplexing problems of our existence. In this address, I shall deal mainly with the physical universe, and say very little about mental determinism or freewill. That might well be left to those who are more accustomed to arguing about such questions, if only they could be awakened to the new situation which has arisen on the physical side. At present I can see little sign of such an awakening

### DEFINITIONS OF DETERMINISM

Let us first be sure that we agree as to what is meant by determinism. I quote three definitions or descriptions for your consideration. The first is by a mathematician (Laplace)

We ought then to regard the present state of the universe as the effect of its antecedent state and the cause of the state that is to follow. An intelligence, who for a given instant should be acquainted with all the forces by which Nature is animated and with the several positions of the entities composing it, if, further, his intellect were vast enough to submit those data to analysis, would include in one and the same formula the movements of the largest bodies in the universe

and those of the lightest atom. Nothing would be uncertain for him, the future as well as the past would be present to his eyes. The human mind in the perfection it has been able to give to astronomy affords a feeble outline of such an intelligence.

All its efforts in the search for truth tend to approximate without limit to the intelligence we have just imagined.

The second is by a philosopher (C. D. Broad)

'Determinism' is the name given to the following doctrine. Let  $S$  be any substance,  $\psi$  any characteristic, and  $t$  any moment. Suppose that  $S$  is in fact in the state  $\sigma$  with respect to  $\psi$  at  $t$ . Then the compound supposition that everything else in the world should have been exactly as it in fact was, and that  $S$  should have been in one of the other two alternative states with respect to  $\psi$  is an impossible one. [The three alternative states (of which  $\sigma$  is one) are to have the characteristic  $\psi$ , not to have it, and to be changing.]

The third is by a poet (Omar Khayyám)

With Earth's first Clay They did the Last Man knead,  
And there of the Last Harvest sow'd the Seed  
And the first Morning of Creation wrote  
What the Last Dawn of Reckoning shall read

I propose to take the poet's description as my standard. Perhaps this may seem an odd choice, but there is no doubt that his words express what is in our minds when we refer to determinism. The other two definitions need to be scrutinised suspiciously, we are afraid there may be a catch in them. In saying that the physical universe as now pictured is not a universe in which "the first morning of creation wrote what the last dawn of reckoning shall read", we make it clear that the abandonment of determinism is no technical quibble, but is to be understood in the most ordinary sense of the words.

It is important to notice that all three definitions introduce the time-element. Determinism postulates not merely causes but pre-existing causes. Determinism means predetermination. Hence in any argument about determinism the dating of the alleged causes is an important matter, we must challenge them to produce their birth certificates.

\* Presidential address to the Mathematical Association delivered on Jan 4

Ten years ago, practically every physicist of repute was, or believed himself to be, a determinist, at any rate so far as inorganic phenomena are concerned. He believed that he had come across a scheme of strictly causal law, and that it was the primary aim of science to fit as much of our experience as possible into such a scheme. The methods, definitions, and conceptions of physical science were so much bound up with this assumption of determinism that the limits (if any) of the scheme of causal law were looked upon as the ultimate limits of physical science.

To see the change that has occurred, we need only refer to a recent book which goes as deeply as anyone has yet penetrated into the fundamental structure of the physical universe, Dirac's "Quantum Mechanics". I do not know whether Dirac is a determinist or not, quite possibly he believes as firmly as ever in the existence of a scheme of strict causal law. But the significant thing is that in this book he has no occasion to refer to it. In the fullest account of what has yet been ascertained as to the way things work, causal law is not mentioned.

This is a deliberate change in the aim of theoretical physics. If the older physicist had been asked why he thought that progress consisted in fitting more and more phenomena into a deterministic scheme, his most effective reply would have been "What else is there to do?" A book such as Dirac's supplies the answer. For the new aim has been extraordinarily fruitful, and phenomena which had hitherto baffled exact mathematical treatment are now calculated and the predictions are verified by experiment. We shall see presently that indeterministic law is as useful a basis for practical predictions as deterministic law was. By all practical tests, progress along this new branch track must be recognised as a great advance in knowledge. No doubt some will say "Yes, but it is often necessary to make a detour in order to get round an obstacle. Presently we shall have passed the obstacle and be able to join the old road again." I should say rather that we are like explorers on whom at last it has dawned that there are other enterprises worth pursuing besides finding the North-West Passage, and we need not take too seriously the prophecy of the old mariners who regard these enterprises as a temporary diversion to be followed by a return to the 'true aim of geographical exploration'. But at the moment I am not concerned with prophecy and counter-prophecy, the important thing is to grasp the facts of the present situation.

## SECONDARY LAW

Let us first try to see how the new aim of physical science originated. We observe certain regularities in the course of Nature and formulate these as 'laws of Nature'. Laws may be stated positively or negatively, 'Thou shalt' or 'Thou shalt not'. For the present purpose it is most convenient to formulate them negatively. Consider the following two regularities which occur in our experience.

(a) We never come across equilateral triangles whose angles are unequal.

(b) We never come across 13 trumps in our hand at bridge.

In our ordinary outlook we explain these regularities in fundamentally different ways. We say that the first occurs because the contrary experience is *impossible*, the second occurs because the contrary experience is *too improbable*.

This distinction is entirely theoretical, there is nothing in the observations themselves to suggest to which type a particular regularity belongs. We recognise that 'impossible' and 'too improbable' can both give adequate explanation of any observed uniformity of experience, and the older theory rather haphazardly explained some uniformities one way and other uniformities the other way. In the new physics we make no such discrimination, the union obviously must be on the basis of (b), not (a). It can scarcely be supposed that there is a law of Nature which makes the holding of 13 trumps in a properly dealt hand impossible, but it *can* be supposed that our failure to find equilateral triangles with unequal angles is only because such triangles are too improbable.

We must, however, first consider the older view which distinguished type (a) as a special class of regularity. Accordingly, there were two types of natural law. The earth keeps revolving round the sun, because it is *impossible* it should run away. Heat flows from a hot body to a cold, because it is *too improbable* that it should flow the other way. I call the first type *primary* law, and the second type *secondary* law. The recognition of secondary law was the thin end of the wedge that ultimately cleft the deterministic scheme.

For practical purposes primary and secondary law exert equally strict control. The improbability referred to in secondary law is so enormous that failure even in an isolated case is not to be seriously contemplated. You would be utterly astounded if heat flowed from you to the fire so that you got chilled by standing in front of it, although such an occurrence is judged by physical theory to be not



impossible but improbable. Now it is axiomatic that in a deterministic scheme nothing is left to chance, a law which has the ghost of a chance of failure cannot form part of the scheme. So long as the aim of physics is to bring to light a deterministic scheme, the pursuit of secondary law is a blind alley since it leads only to probabilities. The determinist is not content with a law which prescribes that, given reasonable luck, the fire will warm me, he admits that that is the probable effect, but adds that somewhere at the base of physics there are other laws which prescribe just what the fire will do to me, luck or no luck.

To borrow an analogy from genetics, determinism is a *dominant character*. We can (and indeed must) have secondary indeterministic laws within any scheme of primary deterministic law—laws which tell us what is likely to happen but are overridden by the dominant laws which tell us what must happen. So determinism watched with equanimity the development of indeterministic law within itself. What matter? Deterministic law remains dominant. It was not foreseen that indeterministic law when fully grown might be able to stand by itself and supplant its dominant parent. There is a game called "Think of a number." After doubling, adding, and other calculations, there comes the direction "Take away the number you first thought of." We have reached that position in physics, and the time has come to take away the determinism we first thought of.

The growth of secondary law within the deterministic scheme was remarkable, and gradually sections of the subject formerly dealt with by primary law were transferred to it. There came a time when in some of the most progressive branches of physics secondary law was used exclusively. The physicist might continue to profess allegiance to primary law but he ceased to utilise it. Primary law was the gold to be kept stored in vaults, secondary law was the paper to be used for actual transactions. No one minded, it was taken for granted that the paper was backed by gold. At last came the crisis, and *physics went off the gold standard*. This happened very recently, and opinions are divided as to what the result will be. Prof. Einstein, I believe, fears disastrous inflation, and urges a return to sound currency—if we can discover it. But most theoretical physicists have begun to wonder why the now idle gold should have been credited with such magic properties. At any rate the thing has happened, and the immediate result has been a big advance in atomic physics.

We have seen that indeterministic or secondary

law accounts for regularities of experience, so that it can be used for predicting the future as satisfactorily as primary law. The predictions and regularities refer to average behaviour of the vast number of particles concerned in most of our observations. When we deal with fewer particles the indeterminacy begins to be appreciable, and prediction becomes more of a gamble, until finally the behaviour of a single atom or electron has a very large measure of indeterminacy. Although some courses may be more probable than others, backing an electron to do anything is in general as uncertain as backing a horse.

It is commonly objected that our uncertainty as to what the electron will do in the future is due not to indeterminism but to ignorance. It is asserted that some character exists in the electron or its surroundings which decides its future, only physicists have not yet learned how to detect it. You will see later how I deal with this suggestion. But I would here point out that if the physicist is to take any part in the wider discussion on determinism as affecting the significance of our lives and the responsibility of our decisions, he must do so on the basis of what he has discovered, not on the basis of what it is conjectured he might discover. His first step should be to make clear that he no longer holds the position, occupied for so long, of chief advocate for determinism, and that he is *unaware* of any deterministic law in the physical universe. He steps aside and leaves it to others—philosophers, psychologists, theologians—to come forward and show, if they can, that they have found indications of determinism in some other way\*. If no one comes forward, the hypothesis of determinism presumably drops, and the question whether physics is actually antagonistic to it scarcely arises. It is no use looking for an opposer until there is a proposer in the field.

#### INFERENTIAL KNOWLEDGE

It is now necessary to examine rather closely the nature of our knowledge of the physical universe.

All our knowledge of physical objects is by inference. We have no means of getting into direct contact with them, but they emit and scatter light waves, and they are the source of pressures transmitted through adjacent material. They are like broadcasting stations that send out signals which

\* With the view of learning what might be said from the philosophical side against the abandonment of determinism, I took part in a symposium of the Aristotelian Society and Mind Association in July 1931. Indeterminists were strongly represented, but unfortunately there were no determinists in the symposium, and apparently none in the audience which discussed it. I can scarcely suppose that determinist philosophers are extinct, but it may be left to their colleagues to deal with them.

we can receive. At one stage of the transmission the signals pass along nerves within our bodies. Ultimately visual, tactual, and other sensations are provoked in the mind. It is from these remote effects that we have to argue back to the properties of the physical object at the far end of the chain of transmission. The image which arises in the mind is not the physical object, though it is a source of information about the physical object, to confuse the mental object with the physical object is to confuse the clue with the criminal. Life would be impossible if there were no kind of correspondence between the external world and the picture of it in our minds, and natural selection (reinforced where necessary by the selective activity of the Lunacy Commissioners) has seen to it that the correspondence is sufficient for practical needs. But we cannot rely on the correspondence, and in physics we do not accept any detail of the picture unless it is confirmed by more exact methods of inference.

The external world of physics is thus a universe populated with *inferences*. The inferences differ in degree and not in kind. Familiar objects which I handle are just as much inferential as a remote star which I infer from a faint image on a photographic plate, or an 'undiscovered' planet inferred from irregularities in the motion of Uranus. It is sometimes asserted that electrons are essentially more hypothetical than stars. There is no ground for such a distinction. By an instrument called a Geiger counter, electrons may be counted one by one as an observer counts one by one the stars in the sky. In each case the actual counting depends on a remote indication of the physical object. Erroneous properties may be attributed to the electron by fallacious or insufficiently grounded inference, so that we may have a totally wrong impression of what it is we are counting, but the same is equally true of the stars.

In the universe of inferences, past, present, and future appear simultaneously, and it requires scientific analysis to sort them out. By a certain rule of inference, namely, the law of gravitation, we infer the present or past existence of a dark companion to a star, by an application of the same rule of inference we infer the existence on Aug. 11, 1999, of a configuration of the sun, earth, and moon, which corresponds to a total eclipse of the sun. The shadow of the moon on Cornwall in 1999 is already in the universe of inference. It will not change its status when the year 1999 arrives and the eclipse is observed, we shall merely substitute one method of inferring the shadow for another. The shadow will always be an inference. I am

speaking of the object or condition in the external world which is called a shadow, our perception of darkness is not the physical shadow, but is one of the possible clues from which its existence can be inferred.

Of particular importance to the problem of determinism are our inferences about the past. Strictly speaking, our direct inferences from sight, sound, touch, all relate to a time slightly antecedent, but often the lag is more considerable. Suppose that we wish to discover the constitution of a certain salt. We put it in a test tube, apply certain reagents, and ultimately reach the conclusion that it *was* silver nitrate. It is no longer silver nitrate after our treatment of it. This is an example of retrospective inference: the property which we infer is not that of 'being X' but of 'having been X'.

We noted at the outset that in considering determinism the alleged causes must be challenged to produce their birth certificates so that we may know whether they really were pre-existing. Retrospective inference is particularly dangerous in this connexion because it involves antedating a certificate. The experiment above mentioned certifies the chemical constitution of a substance, but the date we write on the certificate is earlier than the date of the experiment. The antedating is often quite legitimate, but that makes the practice all the more dangerous, it lulls us into a feeling of security.

#### RETROSPECTIVE CHARACTERS

To show how retrospective inference might be abused, suppose that there were no way of learning the chemical constitution of a substance without destroying it. By hypothesis a chemist would never know until after his experiment what substance he had been handling, so that the result of every experiment he performed would be entirely unforeseen. Must he then admit that the laws of chemistry are chaotic? A man of resource would override such a trifling obstacle. If he were discreet enough never to say beforehand what his experiment was going to demonstrate, he might give edifying lectures on the uniformity of Nature. He puts a lighted match in a cylinder of gas, and the gas burns. "There you see that hydrogen is inflammable." Or the match goes out. "That proves that nitrogen does not support combustion." Or it burns more brightly. "Evidently oxygen feeds combustion." "How do you know it was oxygen?" "By retrospective inference from the fact that the match burned more brightly." And so the experimenter passes from cylinder to cylinder, the

match sometimes behaves one way and sometimes another, thereby beautifully demonstrating the uniformity of Nature and the determinism of chemical law<sup>1</sup>. It would be unkind to ask how the match must behave in order to indicate indeterminism.

If by retrospective inference we infer characters at an earlier date, and then say that those characters invariably produce at a future date the manifestation from which we inferred them, we are working in a circle. The connexion is not causation but definition, and we are not prophets but tautologists. We must not mix up the genuine achievements of scientific prediction with this kind of charlatanry, or the observed uniformities of Nature with those so easily invented by our imaginary lecturer. It is easily seen that to avoid vicious circles we must abolish purely retrospective characteristics—those which are never found as existing but always as having existed. If they do not manifest themselves until the moment that they cease to exist, they can never be used for prediction except by those who prophesy after the event.

Chemical constitution is not a retrospective character, though it is often inferred retrospectively. The fact that silver nitrate can be bought and sold shows that there is a property of *being* silver nitrate as well as of *having been* silver nitrate. Apart from special methods of determining the constitution or properties of a substance without destroying it, there is one general method widely applicable. We divide the specimen into two parts, analyse one part (destroying it if necessary), and show that its constitution *has been* X, then it is usually a fair inference that the constitution of the other part *is* X. It is sometimes argued that in this way a character inferable retrospectively must always be also inferable contemporaneously, if that were true, it would remove all danger of using retrospective inference to invent fictitious characters as causes of the events observed. Actually the danger arises just at the point where the method of sampling breaks down, namely, when we are concerned with characteristics supposed to distinguish one individual atom from another atom of the same substance, for the individual atom cannot be divided into two samples, one to analyse and one to preserve. Let us take an example.

It is known that potassium consists of two kinds of atoms, one kind being radioactive and the other inert. Let us call the two kinds  $K\alpha$  and  $K\beta$ . If we observe that a particular atom bursts in the radioactive manner, we shall infer that it was a  $K\alpha$  atom. Can we say that the explosion was pre-

determined by the fact that it was a  $K\alpha$  and not a  $K\beta$  atom? On the information stated there is no justification at all,  $K\alpha$  is merely an antedated label which we attach to the atom when we see that it has burst. We can always do that, however undetermined the event may be which occasions the label. Actually, however, there is more information which shows that the burst is not undetermined. Potassium is found to consist of two isotopes of atomic weights 39 and 41, and it is believed that 41 is the radioactive kind, 39 being inert. It is possible to separate the two isotopes and to pick out atoms known to be  $K^{41}$ . Thus,  $K^{41}$  is a contemporaneous character, and can legitimately predetermine the subsequent radioactive outburst, it replaces  $K\alpha$  which was a retrospective character.

So much for the fact of outburst, now consider the time of outburst. Nothing is known as to the time when a particular  $K^{41}$  atom will burst except that it will probably be within the next thousand million years. If, however, we observe that it bursts at a time  $t$ , we can ascribe to the atom the retrospective character  $K^t$ , meaning that it had (all along) the property that it was going to burst at time  $t$ . Now, according to modern physics, the character  $K^t$  is not manifested in any way—is not even represented in our mathematical description of the atom—until the time  $t$  when the burst occurs and the character  $K^t$ , having finished its job, disappears. In these circumstances  $K^t$  is not a pre-determining cause. Our retrospective labels and characters add nothing to the plain observational fact that the burst occurred without warning at the moment  $t$ , they are merely devices for ringing a change on the tenses.

The time of break-up of a radioactive atom is an example of extreme indeterminism; but it must be understood that, according to current theory, all future events are indeterminate in greater or lesser degree, and differ only in the margin of uncertainty. When the uncertainty is below our limits of measurement, the event is looked upon as practically determinate, determinacy in this sense is relative to the refinement of our measurements. A being accustomed to time on the cosmic scale, who was not particular to a few hundred million years or so, might regard the time of break-up of the radioactive atom as practically determinate. There is one unified system of secondary law throughout physics and a continuous gradation from phenomena predictable with overwhelming probability to phenomena which are altogether indeterminate.

## CRITICISM OF INDETERMINISM

In saying that there is no contemporaneous characteristic of the radioactive atom determining the date at which it is going to break up, we mean that in the picture of the atom as drawn in present-day physics no such characteristic appears, the atom which will break up in 1960 and the atom which will break up in the year 150,000 are drawn precisely alike. But, it will be said, surely that only means that the characteristic is one which physics has not yet discovered, in due time it will be found and inserted in the picture either of the atom or its environment. If such indeterminacy were exceptional, that would be the natural conclusion, and we should have no objection to accepting such an explanation as a likely way out of a difficulty. But the radioactive atom was not brought forward as a difficulty, it was brought forward as a favourable illustration of that which applies in greater or lesser degree to all kinds of phenomena. There is a difference between explaining away an exception and explaining away a rule.

The persistent critic continues: "You are evading the point. I contend that there are characteristics unknown to you which completely predetermine not only the time of break-up of the radioactive atom but also all physical phenomena. How do you know there are not? You are not omniscient."

The curious thing is that the determinist who takes this line is under the illusion that he is adopting a more modest attitude in regard to our scientific knowledge than the indeterminist. The indeterminist is accused of claiming omniscience. I will not make quite the same countercharge against the determinist, but surely it is only a man who thinks himself *nearly* omniscient who would have the audacity to start enumerating all the things which (it occurs to him) might exist without his knowing it. I am so far from omniscient that my list would contain innumerable entries. If it is any satisfaction to the critic, my list does include deterministic characters—along with Martian irrigation works, ectoplasm, etc.—as things which might exist unknown to me.

It must be realised that determinism is a positive assertion about the behaviour of the universe. It is not sufficient for the determinist to claim that there is no fatal objection to his assertion, he must produce some reason for making it. I do not say he must prove it, for in science we are ready to believe things on evidence falling short of strict proof. If no reason for asserting it can be given,

it collapses as an idle speculation. It is astonishing that even scientific writers on determinism advocate it without thinking it necessary to say anything in its favour, merely pointing out that the new physical theories do not actually disprove determinism. If that really represents the status of determinism, no reputable scientific journal would waste space over it. Conjectures put forward on slender evidence are the curse of science, a conjecture for which there is no evidence at all is an outrage. So far as the physical universe is concerned, determinism appears to explain nothing for in the modern books which go farthest into the theory of the phenomena no use is made of it.

Indeterminism is not a positive assertion. I am an indeterminist in the same way that I am an anti-moon-is-made-of-green-cheese-ist. That does not mean that I especially identify myself with the doctrine that the moon is *not* made of green cheese. Whether or not the green cheese lunar theory can be reconciled with modern astronomy is scarcely worth inquiring, the main point is that green-cheesism, like determinism, is a conjecture that we have no reason for entertaining. Undisprovable hypotheses of that kind can be invented *ad lib*.

## PRINCIPLE OF UNCERTAINTY

The mathematical treatment of an indeterminate universe does not differ much in form from the older treatment designed for a determinate universe. The equations of wave mechanics used in the new theory are not different in principle from those of hydrodynamics. The fact is that, since an algebraic symbol can be used to represent either a known or an unknown quantity, we can symbolise a definitely predetermined future or an unknown future in the same way. The difference is that whereas in the older formulæ every symbol was theoretically determinable by observation, in the present theory there occur symbols the values of which are not assignable by observation.

Hence, if we use the equations to predict, say, the future velocity of an electron, the result will be an expression containing, besides known symbols, a number of undeterminable symbols. The latter make the prediction indeterminate. (I am not here trying to prove or explain the indeterminacy of the future, I am only stating how we adapt our mathematical technique to deal with an indeterminate future.) The indeterminate symbols can often (or perhaps always) be expressed as unknown phase-angles. When a large number of phase-angles are involved, we may assume in averaging that they are uniformly distributed from  $0^\circ$  to

360°, and so obtain predictions which could only fail if there has been an unlikely coincidence of phase-angles. That is the secret of all our successful prophecies, the unknowns are not eliminated by determinate equations but by averaging.

There is a very remarkable relation between the determined and the undetermined symbols, which is known as Heisenberg's Principle of Uncertainty. The symbols are paired together, every determined symbol having an undetermined symbol as partner. I think that this regularity makes it clear that the occurrence of undetermined symbols in the mathematical theory is not a blemish, it gives a special kind of symmetry to the whole picture. The theoretical limitation on our power of predicting the future is seen to be systematic, and it cannot be confused with other casual limitations due to our lack of skill.

Let us consider an isolated system. It is part of a universe of inference, and all that can be embodied in it must be capable of being inferred from the influence which it broadcasts over its surroundings. Whenever we state the properties of a body in terms of physical quantities, we are imparting knowledge as to the response of various external indicators to its presence and nothing more. A knowledge of the response of all kinds of objects would determine completely its relation to its environment, leaving only its unget-at-able inner nature, which is outside the scope of physics. Thus, if the system is really isolated so that it has no interaction with its surroundings, it has no properties belonging to physics, but only an inner nature which is beyond physics. So we must modify the conditions a little. Let it for a moment have some interaction with the world exterior to it, the interaction starts a train of influences which may reach an observer, he can from this one signal draw an inference about the system, that is, fix the value of one of the symbols describing the system or fix one equation for determining their values. To determine more symbols there must be further interactions, one for each new value fixed. It might seem that in time we could fix all the symbols in this way, so that there would be no undetermined symbols in the description of the system. But it must be remembered that the interaction which disturbs the external world by a signal also reacts on the system.

There is thus a double consequence, the interaction starts a signal through the external world informing us that the value of a certain symbol  $p$  in the system is  $p_1$ , and at the same time it alters to an indeterminable extent the value of another

symbol  $q$  in the system. If we had learned from former signals that the value of  $q$  was  $q_1$ , our knowledge will cease to apply, and we must start again to find the new value of  $q$ . Presently there may be another interaction which tells us that  $q$  is now  $q_2$ , but the same interaction knocks out the value  $p_1$  and we no longer know  $p$ . It is of the utmost importance for prediction that a paired symbol and not the inferred symbol is upset by the interaction. If the signal taught us that at the moment of interaction  $p$  was  $p_1$ , but that  $p$  had been upset by the interaction and the value no longer held good, we should never have anything but retrospective knowledge—like the chemistry lecturer to whom I referred above. Actually we can have contemporaneous knowledge of the values of half the symbols, but never more than half. We are like the comedian picking up parcels who, each time he picks up one, drops another.

There are various possible transformations of the symbols and the condition can be expressed in another way. Instead of two paired symbols, one wholly known and the other wholly unknown, we can take two symbols each of which is known with some uncertainty, then the rule is that the product of the two uncertainties is fixed. Any interaction which reduces the uncertainty of determination of one increases the uncertainty of the other. For example, the position and velocity of an electron are paired in this way. We can fix the position with a probable error of 0.001 mm and the velocity with a probable error of about 1 km per sec, or we can fix the position to 0.0001 mm and the velocity to 10 km per sec, and so on. We divide the uncertainty how we like, but we cannot get rid of it. If current theory is right, this is not a question of lack of skill or a perverse delight of Nature in tantalising us, for the uncertainty is actually embodied in the theoretical picture of the electron, so that if we describe something as having exact position and velocity we cannot be describing an electron.

If we divide the uncertainty in position and velocity at time  $t_1$  in the most favourable way, we find that the predicted position of the electron one second later (at time  $t_2$ ) is uncertain to about five centimetres. That represents the extent to which the future position is not predetermined by anything existing one second earlier. If the position at time  $t_2$  always remained uncertain to this extent, there would be no failure of determinism, for the thing we had failed to predict (exact position at time  $t_2$ ) would be meaningless. But *when the second has elapsed* we can measure the position of the electron to 0.001 mm or even more closely, as

already stated This accurate position is not predetermined, we have to wait until the time arrives and then measure it It may be recalled that the new knowledge is acquired at a price Along with our rough knowledge of position (to 5 cm) we had a fair knowledge of the velocity, but when we acquire more accurate knowledge of the position, the velocity goes back into extreme uncertainty

We might spend a long while admiring the detailed working of this cunning arrangement by which we are prevented from finding out more than we ought to know But I do not think we should look on these as Nature's devices to prevent us from seeing too far into the future. They are the devices of the mathematician who has to protect himself from making impossible predictions It commonly happens that when we ask silly questions, mathematical theory does not directly refuse to answer but gives a non-committal answer like  $\frac{0}{0}$ , out of which we cannot wring any definite meaning Similarly, when we ask where the electron will be to-morrow, mathematical theory does not give the straightforward answer, "It is impossible to say, because it is not yet decided", because that is beyond the resources of an algebraic vocabulary It gives us an ordinary formula of  $x$ 's and  $y$ 's, but makes sure that we cannot possibly find out what the formula means—until to-morrow

#### MENTAL INDETERMINISM

I have, perhaps fortunately, left myself no time to discuss the effect of indeterminacy in the physical universe on our general outlook I will content myself with stating in summary form the points which seem to arise

(1) If the whole physical universe is deterministic, mental decisions (or at least *effective* mental decisions) must also be predetermined For if it is predetermined in the physical world (to which your body belongs) that there will be a pipe between your lips on Jan 1, the result of your mental struggle on Dec 31 as to whether you will give up smoking in the New Year is evidently predetermined The new physics thus opens the door to indeterminacy of mental phenomena, whereas the old deterministic physics bolted and barred it completely

(2) The door is opened slightly, but apparently the opening is not wide enough, for according to analogy with inorganic physical systems, we should expect the indeterminacy of human movements to be quantitatively insignificant In some way we must transfer to human movements the

wide indeterminacy characteristic of atoms, instead of the almost negligible indeterminacy manifested by inorganic systems of comparable scale I think this difficulty is not insuperable, but it must not be underrated

(3) Although we may be uncertain as to the intermediate steps, we can scarcely doubt what is the final answer If the atom has indeterminacy, surely the human mind will have an equal indeterminacy, for we can scarcely accept a theory which makes out the mind to be more mechanistic than the atom

(4) Is the human will really more free if its decisions are swayed by new factors born from moment to moment than if they are the outcome solely of heredity, training, and other predetermining causes? On such questions as these we have nothing new to say Argument will no doubt continue 'about it and about' But it seems to me that there is a far more important aspect of indeterminacy. It makes it possible that the mind is not utterly deceived as to the mode in which its decisions are reached On the deterministic theory of the physical world, my hand in writing this address is guided in a predetermined course according to the equations of mathematical physics; my mind is unessential—a busybody who invents an irrelevant story about a scientific argument as an explanation of what my hand is doing—an explanation which can only be described as a downright lie If it is true that the mind is so utterly deceived in the story it weaves round our human actions, I do not see where we are to obtain our confidence in the story it tells of the physical universe

Physics is becoming difficult to understand First relativity theory, then quantum theory, then wave mechanics have transformed the universe, making it seem ever more fantastic to our minds Perhaps the end is not yet But there is another side to this transformation Naïve realism, materialism, the mechanistic hypothesis were simple, but I think that it was only by closing our eyes to the essential nature of experience, relating as it does to the reactions of a conscious being, that they could be made to seem credible. These revolutions of scientific thought are clearing up the deeper contradictions between life and theoretical knowledge, and the latest phase with its release from determinism marks a great step onwards I will even venture to say that in the present theory of the physical universe we have at last reached something which a reasonable man might almost believe.



### Announcements

THE annual Sir John Rhys Memorial Lecture of the British Academy will be delivered on Feb. 17 by Prof. H. J. Fleure, professor of geography in the University of Manchester, who will take as his subject "Archæology and Folk-Tradition".

THE ninety-first annual general meeting of the Chemical Society will be held in Glasgow on March 18, under the presidency of Prof. G. G. Henderson, regius professor of chemistry in the University of Glasgow, who will take as the subject for his address "The Publication of Chemical Literature". This will be the first official visit of the Society to Scotland.

THE Right Hon. Lord Plender; Mr. Bertram S. Thomas, Arabian explorer and orientalist; and the Rev. A. T. P. Williams, headmaster of Winchester College, have been elected members of the Athenæum under the provisions of Rule II. of the Club, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public services.

THE Langley Prize, which is usually awarded every three years for the best paper submitted by officers of the West African Medical Service—whether on the active or retired list—has been awarded by the London School of Hygiene and Tropical Medicine in equal shares for Dr. E. C. Smith's paper "A Dermatological Atlas of Nigeria" and for Dr. Hope Gill's paper "Diagnostic Methods in Human Trypanosomiasis".

THE following appointments in the Colonial Agricultural Service have recently been made by the Secretary of State for the Colonies: Mr. G. E. Bodkin, Government entomologist, Palestine, to be director of agriculture, Mauritius; Mr. A. S. Thomas, economic botanist, Gold Coast, to be assistant botanist, Uganda; Mr. J. E. P. Booth, to be agricultural officer, Kenya; Mr. R. E. T. Hobbs, to be agricultural officer, Kenya; Mr. W. T. Dalgarno, to be agricultural instructor, Bahamas; Mr. J. C. Eyre, to be district agricultural officer, Tanganyika Territory.

IN view of the present situation, and the recent appointment of Dr. C. P. Blacker as general secretary of the Eugenics Society, the salaried appointment of Mrs. C. B. S. Hodson will terminate next August. Mrs. Hodson is to continue to work in close association with the Society as a member of the council, and so secure the continuation of the eugenic work already begun in different parts of Great Britain. This arrangement leaves unaffected Mrs. Hodson's position as honorary administrative secretary to the International Federation of Eugenic Organizations, and she retains her place on the Committee for Legalising Eugenic Sterilization.

OWING to the closing of Chillingham Castle, Northumberland, efforts are being made to keep together the famous herd of wild cattle which is believed to have roamed in the castle enclosure since the thirteenth century. It is announced in the *Times* of Feb. 8 that the Zoological Society of London has

undertaken to contribute £100 a year for seven years if a lease at £500 a year for that period is granted to three trustees nominated by the Society. The remainder of the £500 a year is to be provided by public subscription. The trustees are Lord Grey of Fallodon, Mr. Hugh S. Gladstone, and Sir Peter Chalmers Mitchell. A public appeal will shortly be made.

WE have received List No. 23, January 1932, of Eastman Organic Chemicals, from the Eastman Kodak Co., Rochester, New York. This contains the names of a large number of special chemicals already available, and also several additions, the specification of which occupies six pages of the catalogue. The prices of all the chemicals are given, and a valuable feature of the list is the inclusion of the physical constants of nearly all the chemicals.

MR. C. R. S. MANDERS suggests in a letter to the Editor that a magnetic field might produce a marked change in the specific inductive capacity of substance. The suggestion is fairly obvious, but no references are given to work upon the subject; and as Mr. Manders gives no address, we are unable to return his letter.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant secretary of the University of Birmingham—The Secretary, University, Birmingham (Feb. 15). A senior assistant hydrometric engineer in the Civil Engineering Department of the Electricity Supply Board of the Irish Free State—The Secretary, Electricity Supply Board, 60-62 Upper Mount Street, Dublin (Feb. 17). A senior assistant in the library of the University College of Hull—The Registrar, University College, Hull (Feb. 19). An assistant master, mainly for chemistry and physics, at the Acton Technical College—The Principal, Technical College, Acton (Feb. 20). A junior lecturer in the Department of Pathology, University of Liverpool—The Professor of Pathology, University, Liverpool (Feb. 21). A lecturer in engineering at the Wigan and District Mining and Technical College—The Principal, Wigan and District Mining and Technical College, Wigan (Feb. 22). A head of the Department of Industrial and Fine Art, Loughborough College—The Registrar, Loughborough College, Loughborough (Feb. 26). A principal of the Westminster Technical Institute—The Education Officer (T.1), County Hall, Westminster Bridge, S.E.1 (Feb. 29). A lecturer in experimental pathology and assistant director of cancer research in the University of Leeds—The Registrar, University, Leeds (March 1). A professor of anatomy in the University of Lucknow—The Registrar, Lucknow University, Lucknow, India (March 30). A part-time lecturer in Sinhalese at the School of Oriental Studies—The Secretary, School of Oriental Studies, Finsbury Circus, E.C.2 (April 20). A lecturer in English in the University of Hong Kong—The Secretary, Universities Bureau of the British Empire, 88A Gower Street, W.C.1 (April 30). A professor of agricultural botany in the University of Reading—The Registrar, University, Reading.



## Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

## Artificial Production of Fast Protons

A HIGH potential laboratory has been developed at the Cavendish Laboratory for the study of the properties of high speed positive ions. The potential from a high voltage transformer is rectified and multiplied four times by a special arrangement of rectifiers and condensers, giving a working steady potential of 800 kilovolts. Currents of the order of a milliampere may be obtained at a potential constant to 1.2 per cent.

Protons from a discharge in hydrogen are directed down the axis of two glass cylinders 14 in. in diameter and 36 in. long, and accelerated by the steady potentials of the rectifier. They are then passed into an experimental chamber at atmospheric pressure through a mica window having a stopping power of about 1 mm. air equivalent. Luminescence of the air can easily be observed.

The ranges of the protons in air and hydrogen have been measured using a fluorescent screen as a detector. The range in air at S.T.P. of a proton having a velocity of  $10^9$  cm./sec. is found to be 8.2 mm., whilst the corresponding range for hydrogen is 3.2 cm. The observed ranges support the general conclusions of Blackett on the relative ranges of protons and  $\alpha$ -particles, although the absolute values of the ranges are lower for both gases. The ranges and stopping power will be measured more accurately by an ionisation method.

The maximum energy of the protons produced up to the present has been 710 kilovolts with a velocity of  $1.16 \times 10^9$  cm./sec. and a corresponding range in air of 13.5 mm. at S.T.P. We do not anticipate any difficulty in working up to 800 kilovolts with our present apparatus.

J. D. COCKROFT.  
E. T. S. WALTON.

Cavendish Laboratory,  
Cambridge, Feb. 2.

Structure of Normal and Mutant Eyes in *Gammarus chevreuxi*

Numerous mutant types of eye have been found in *Gammarus chevreuxi* by Sexton, and their genetic behaviour analysed by her and various other workers.<sup>1</sup> We have now examined the structure of some of these, and find certain surprising results. The normal or wild type eye is of the usual structure,<sup>2</sup> with hypodermis, crystalline cones, rhabdomes, and reticular cells. Prolongations of the reticular cells surround the rhabdomes and the base of the cones, and are the seat of both the red and black pigments of the eye. In addition, between the rhabdomes and cones are to be seen interstitial cells, which contain the interommatidial white pigment characteristic of so many gammarids.

The albino mutant is a simple recessive (*ccW*, as against *CW* for wild type, where *C-c* is the gene controlling the appearance of red and black pigments). It lacks both red and black pigment; the eye is irregular and entirely white. Sections (Fig. 1) show that the crystalline cones are present, but irregularly spheroidal and situated at various levels instead of conical and at a constant level; the bulk of the eye consists of interstitial cells, much hypertrophied in size and possibly increased in number. There is a total absence of retinula. No connexion exists between eye and brain, and the optic ganglion also appears to be absent. In most cases the eye in section is of a fairly regular flattened cake-like shape, but sometimes irregular prolongations of the interstitial tissue extend somewhat into the interior of the head.

The colourless eye is the product of two recessive genes (*ccww* in genetic constitution, where *W-w* is the gene controlling the appearance of white pigment). In sections, colourless eyes are in general similar to albino eyes. But the crystalline cones are usually increased in number, and may be irregularly fused with each other in a very peculiar way, while the interstitial tissue may be somewhat reduced, and may show signs of degeneration (abnormally staining nuclei, and crystalline inclusions in the cells).

In both albino and colourless eyes a peculiar large-celled spongy tissue pervades much of the head; the origin and nature of this has not yet been satisfactorily determined. It might possibly be a modification of the connective tissue found surrounding

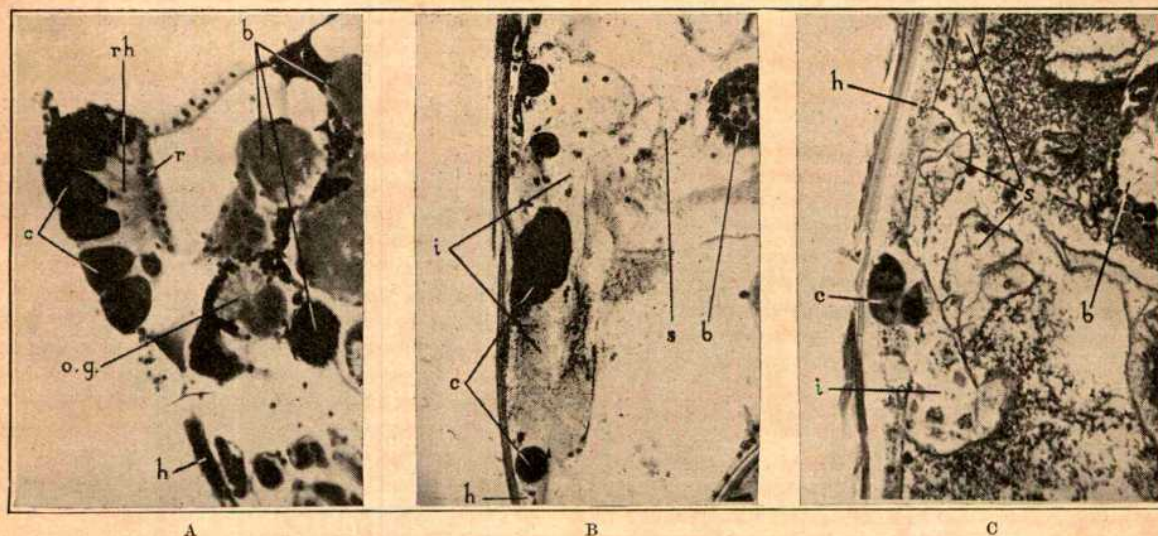


FIG. 1.—Sections of normal and mutant eyes of *Gammarus chevreuxi*. A, normal eye; B, albino eye; C, colourless eye. *b*, brain; *c*, crystalline cones; *h*, hypodermis, with overlying cuticle; *i*, interstitial tissue; *o.g.*, optic ganglion; *r*, reticular tissue; *rh*, position of rhabdomes (and interstitial cells in normal); *s*, spongy tissue (in mutants).



the brain in the wild type, or may be derived from the abnormal development of reticular and optic ganglion rudiments.

The main differentiation of the eye occurs from about two days before hatching (at 23° C) to a little after hatching. Sections taken of embryos during this period show that from the outset the cells which should give rise to reticular tissue are very much reduced in number in albinos; the first origin of interstitial tissue appears to take place at the usual time.

It is hoped to make a further analysis of the earlier developmental processes leading to the mutant types. Meanwhile the work has already explained one genetic puzzle. In most known cases of mendelising colour-characters, single mutations affect the chemical processes leading to the formation of one particular kind of pigment. But the *cc* mutation of *Gammarus* affects two wholly different kinds of pigment, a red lipochrome and a black melanin. This is now seen to be due to the fact that both these pigments are normally present only in the reticular cells, and that the primary effect of the *c* gene is to prevent the development of these cells.

As the albino and colourless eyes are so defective in structure, and have no connexion with the brain, they would be expected to be functionless. This appears to be the case. Normal *Gammarus* are slightly negatively phototropic; albino specimens appear not to be. Owing to the constant restless swimming of this species only statistical results can be obtained. A long tube containing twenty specimens was illuminated from one end and the number of specimens in the half nearer the light counted at regular intervals. In a series of experiments the average percentage of animals in the half nearer the source of light was 35 per cent for wild type, but 45 per cent for albinos. Further, from experiments in which the tube is reversed at regular intervals, it seems that there is a true directive effect of light in the wild type, but that the distribution of the albinos is a matter of chance; for the number of specimens in the half nearer the light is *always* less than 50 per cent in the wild type, while in the albinos it alternates regularly between less than 50 per cent and more than 50 per cent. It is very difficult to make good sections from the adult eyes. We have to thank Dr H. Eltringham, who has special experience with arthropods, for kindly cutting the adult specimens here described and illustrated.

JULIAN S. HUXLEY  
A. WOLSKY.

King's College, London,  
Dec 22

<sup>1</sup> References in Allen and Sexton, *J. Genet.*, 9, 347, 1920; Sexton, Clark, and Spooner, *J. Mar. Biol. Ass.*, 17, 189, 1930; Huxley, *Brit. J. Exp. Biol.*, 1, 79, 1923.

<sup>2</sup> Schatz, E., *Z. wiss. Zool.*, 135, 539, 1929.

### Photochemical Reaction between Hydrogen and Chlorine in the Presence of Oxygen

It has been generally assumed that the hydrogen chloride produced when a mixture of hydrogen and chlorine is illuminated has no effect on the velocity of reaction. If, however, the magnitudes of the Draper effects are considered for two reaction mixtures which do not differ in hydrogen, chlorine, and oxygen concentrations, but only in the circumstance that one (a) contains no hydrogen chloride, and the other (b) an amount of hydrogen chloride equal, say, to that of the concentration of chlorine, then the magnitude of the Draper effect in (a) can be observed to fall off very rapidly on illumination, while that of (b) shows no such rapid initial fall but is always smaller than the initial value in the case of (a).

Indications of a rapid initial fall in reaction velocity in mixtures containing initially no hydrogen chloride can indeed be recognised in the 'velocity coefficients' given by several workers, for example, by Bodenstein and Dux.<sup>1</sup>

Experiment has shown that the presence of hydrogen chloride (in the reaction vessel) does markedly inhibit the reaction. The apparatus employed was essentially that described by Griffiths and Norrish.<sup>2</sup> With the plane-faced quartz and glass reaction vessels here used, chlorine at 50 mm pressure absorbed about fifty per cent of the incident light of wave-length 365  $\mu$ . By calibrating the light absorption against concentration, concentrations of chlorine in this region could be determined from the absorption with an accuracy greater than 0.5 mm. This was the method of measurement of hydrogen chloride formation, quantum efficiency figures in general being repeatable with an accuracy within 5 per cent.

Some experimental figures for two wave-lengths are given graphically in Fig. 1, which refers always to an average pressure of chlorine and hydrogen equal

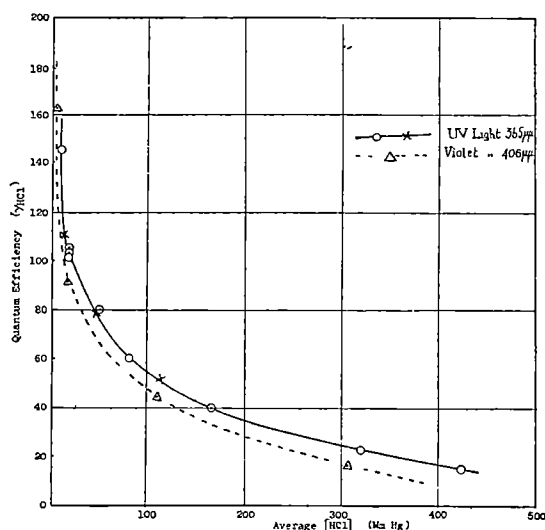


FIG. 1.

to 44 mm each, and a pressure of oxygen equal to 50 mm. The two curves are directly comparable, and the efficiency of the formation per absorbed quantum is always less for light of wave-length 406  $\mu$  than for light of 365  $\mu$ .

Experiments with low oxygen concentration (<10 mm) gave similar results. Our results to date are closely reproduced by the following expression for the quantum efficiency of hydrogen chloride formation

$$\gamma_{\text{HCl}} = \frac{k_1}{(\text{O}_2)([\text{HCl}] + k_2)}$$

This formula has been established so far over a range of pressure of oxygen of from 10 mm to 350 mm, and for a ten-fold variation in light intensity, it will, however, be somewhat amplified when we have completed the study of the separate variation of the hydrogen and chlorine concentrations, which up to the present have been kept constant.

That the inhibiting action of hydrogen chloride as it accumulates is quite specific and unconnected with any 'inert gas effect' is evidenced by the fact that the addition of nitrogen has no action on the course of the reaction. The results were always repeatable to within 5 per cent, whether the hydrogen chloride was added to the system, or allowed to accumulate.

as the result of reaction, and no irregularities were ever observed such as would indicate the presence of chance inhibitors

A series of experiments was also carried out with phosphorus pentoxide in the reaction vessel. Provided the phosphorus pentoxide was dry, no absorption of hydrogen chloride occurred, and the pressure change, measured by a Bourdon gauge, indicated the rate of formation of water. The quantum efficiency of water formation rose from a low value ( $<0.2$ ) to a value not greater than 1 as the hydrogen chloride concentration was increased from zero to 400 mm (oxygen, 50 mm, average chlorine and average hydrogen, 44 mm). The chains of the hydrogen chloride reaction must therefore be broken by the hydrogen chloride and oxygen, acting jointly, possibly in a ternary collision of  $H$ ,  $O_2$ , and  $HCl$ , with water as one of the products.

The inhibiting action of hydrogen chloride puts a new complexion on the kinetics of the hydrogen-chlorine reaction. Neglect of this factor is responsible for the diverse quantum efficiencies recorded by different observers. When it is taken into consideration in systems containing oxygen, the quantum efficiency is surprisingly repeatable. In cases where a water actinometer is used, the hydrogen chloride is absorbed as it is formed, and in any given system there will be a certain arbitrary equilibrium concentration of hydrogen chloride (dependent on the light intensity and dimensions of the vessel) which will control the speed of the action. In this connexion the results of Allmand and Beesley,<sup>3</sup> who report a maximum in the apparent quantum efficiency as the wave-length of the active light is decreased from  $436\text{ }\mu$  to  $365\text{ }\mu$ , must be reconsidered. It seems likely that with the high intensity light of these wave-lengths, greater equilibrium concentrations of hydrogen chloride were established in the actinometer than with the less intense violet ( $406\text{ }\mu$ ) light obtainable from the mercury vapour lamp. The quantum efficiency would therefore show an apparent maximum in the violet. We have shown above, however, that when the concentration of hydrogen chloride is also taken into account, the quantum efficiency increases between  $406\text{ }\mu$  and  $365\text{ }\mu$ .

MOWBRAY RITCHIE  
R. G. W. NORRISH

Department of Physical Chemistry,  
University, Cambridge,  
Jan 8

- <sup>1</sup> *Z. physik. Chem.*, **85**, 316, 1913  
<sup>2</sup> *Proc. Roy. Soc., A*, **130**, 591, 1931  
<sup>3</sup> *J. Chem. Soc.*, 2709, 1930

#### Co-ordination of Hydrogen in Associated Liquids

SIMONS and Bouknight<sup>1</sup> have described measurements of the density and surface tension of hydrogen fluoride at various temperatures, but in their discussion, although they calculate the Eotvos constant, they do not give any value of the parachor.

Using their results and the measurements of the vapour density made by Simons and Hildebrand in 1924, the parachor can be evaluated, and the figures show that it increases from 34.2 at  $-80^\circ$  to 35.8 at  $19.5^\circ$ .

This result is an interesting addition to those quoted by Sidgwick and Bayliss<sup>2</sup> in support of their ideas on the co-ordination of hydrogen in associated liquids. The 'theoretical' parachor for hydrogen fluoride is 42.8, so that the actual value shows a defect nearly equal to the 7.2 which should characterise a liquid associating to double molecules, moreover, the defect

decreases steadily with rise of temperature, as was to have been anticipated, suggesting a decrease in the extent of the association.

It is noteworthy that if, on the other hand, single electron bonds are assumed in order to avoid the expansion of the electronic group of the hydrogen atom implied above, then a smaller degree of association would be required to account for the defect observed—a smaller one than perhaps seems likely from other considerations.

J. C. SPEAKMAN

Chemistry Department,  
University, Sheffield,  
Jan 27

- <sup>1</sup> *J. Amer. Chem. Soc.*, **53**, 129, 1932  
<sup>2</sup> *J. Chem. Soc.*, 2027, 1930

#### Oxygen and Everest

THERE are one or two statements in Sir Leonard Hill's letter, and that of Dr. Greene, in *NATURE* of Jan. 16, which I think require comment and correction.

It would surely be difficult to instance a more cogent demonstration of the possibilities of high altitude acclimatisation than that provided by the recent Bavarian expedition to Kangchenjunga. The climbing party were able by reason of slow upward progress, consequent upon the extreme difficulties of the lower part of their route, to attain such a degree of acclimatisation that at approximately 26,000 ft they were ascending, in deep snow, at the remarkable rate of 650 ft per hour. Sir Leonard altogether fails to appreciate what this performance means, and the fact that the party were carrying very heavy loads makes it all the more remarkable. Sir Leonard elsewhere emphasises that one (though only one) of the party had heart-trouble. In the circumstances, was it not surprising that more of the party had not heart- and other organic troubles? We find, however, that their later strenuous activities in the region, during their return, suggest neither deterioration nor organic degeneration as a result of their amazing efforts on the mountain.

Sir Leonard is incorrect in his statement that the climbers on the last Everest expedition, who persevered at 28,000 ft, all came to grief.<sup>1</sup> As mentioned in my last letter, neither Norton nor Somervell were in the pink of condition when they commenced their climb, and Norton, who persisted to about 28,126 ft, turned back because of the lateness of the hour and his anxiety to regain Somervell before nightfall. He had by no means come to grief, and could have persevered higher, in spite of eye trouble consequent upon having removed his snow-goggles earlier in the day. The strength of re-radiated light at these altitudes, even from bare rock surfaces, had been sufficient to affect his unprotected eyes. Moreover, none of the 1924 Everest party can be said to have suffered, like the animals of the experiment, degenerate organic change from their sojourn at high altitudes. On leaving Tibet they were mostly in excellent condition, and no one has suffered any after-effects.

It may well be that the cats, rats, and mice, etc., of Dr. Campbell's experiment showed no interest in continuing to live at the low oxygen partial pressures to which they were subjected, in spite of being brought gradually to such pressures. But the latter process quite obviously did not constitute acclimatisation, nor was it at all likely to do so considering the complete inactivity meanwhile of the subjects of the experiment.

Whatever analogies, however, on a physical basis may be drawn, such experiments on animals entirely leave out of account the psychological factor so germane to all man's higher activities. The will

to climb higher, the exhilaration of possible success, apart from the accompanying stimulating effects of environment in this case. These psychological factors have their physical reactions, which are quite certainly of a beneficial character.

As we have said before, however, though acclimatisation to the highest altitudes should be aimed at, and has, we believe, already been demonstrated to 27,000 ft in 1924, we recommended at that time that light oxygen equipment be available in case of need on another Everest attempt. Whether such apparatus be used by the actual climbing party on emergency, or merely for experimental purposes on an attached 'physiological squad', it would be desirable to have it as light in weight as possible. If the metallurgist could be prevailed upon to devise an even lighter alloy for gas cylinders than the 'Vibrac' steel used in 1924, it might so materially reduce the total load and bulk of the apparatus as to warrant belief in its possible practicability, either on the final portion of the ascent or for use in high camps by unacclimatised persons, or even during spells of intense cold under the latter conditions some persons have reported experiencing benefit from breathing oxygen—but this is only another symptom of inadequate acclimatisation.

Liquid oxygen apparatus has been considered, but has been ruled out as quite impracticable for mountain use.

Finally, Sir Leonard queries whether the failure of the hill-peoples of the Himalaya to go above 18,000 ft during the summer months may not be on account of realisation of the physiological injuriousness of doing so. The alternative, of the upper limit of pastures, must surely here be the deciding factor, since, so far as I am aware, no grazing beyond that sufficient for the burhel and other mountain sheep exists above 18,000 ft in any part of the Himalaya. Most plants, even of the simple alpine types, cease at 18,000-19,000 ft, although on Everest and Kangchenjunga hardy species of *Arenaria* and *Delphinium* have been found as high as 20,400 ft and 20,600 ft respectively but these are exceptions.

N E ODELL

Clare College,  
Cambridge, Jan 31.

#### Atomic Weight of Fluorine

We find ourselves in complete agreement with Prof Moles's remarks<sup>1</sup> on the values which can be obtained for the atomic weight of fluorine from the limiting densities of silicon fluoride. It appears to us, however, that when two theoretically calculated compressibility coefficients applied to the same data lead to values of the atomic weight of fluorine of 19.09 and 18.995 respectively, little significance can be attached to either of these values.

We would like to point out that the work of McAdam and Smith<sup>2</sup> on the ratio of sodium chloride to sodium fluoride gave an atomic weight of 19.015 when their weighings were not corrected to a vacuum. These results have been corrected to a vacuum by Smith and Haagen (*Carnegie Institution Report*, No 267, p 47), who thus find the value 19.009 (not 19.019 as stated by Prof Moles).

In our original letter we did not bring forward the work of Smith and Haagen (*Carnegie Institution Report*, No 267) on the ratio of borax to various other salts, as these lead to an atomic weight of boron differing considerably from the accepted value. If, however, we assume that the cross ratios from their mean values give trustworthy data for finding the atomic

weight of fluorine, we obtain the following results (taking Na = 22.997, C = 12.005, N = 14.009, S = 32.068)

| Cross ratio |                                 | At Wt Fluorine |
|-------------|---------------------------------|----------------|
| NaF         | NaCl                            | 19.001         |
| 2 NaF       | Na <sub>2</sub> SO <sub>4</sub> | 19.003         |
| NaF         | NaNO <sub>3</sub>               | 19.004         |
| 2 NaF       | Na <sub>2</sub> CO <sub>3</sub> | 19.008         |
|             |                                 | Average 19.004 |

Smith and Haagen themselves give an average value  $F = 19.005$ . Combining Smith and Haagen's results with those of McAdam and Smith, it seems likely that, as we suggested in our original communication, the stoichiometric atomic weight of fluorine lies in the neighbourhood of 19.01 rather than 19.00.

Prof Moles has suggested that our preliminary higher value for the atomic weight (19.01) is due to the gas, which was made by Collie's method, consisting of a constant boiling mixture of methyl fluoride and 2 per cent of methane. This could not explain the divergence, since if the presence of such an amount of methane were assumed, the pure methyl fluoride would give an atomic weight of the order of 19.4.

We have read Gonzalez's paper<sup>3</sup> on the preparation of methyl fluoride by Collie's method. We consider that his results afford no evidence that the purified methyl fluoride he prepared in this way consisted of a constant boiling mixture of methyl fluoride and methane. He did not detect the presence of methane in his purified gas, but merely inferred the existence of a constant boiling mixture, since the vapour pressure and the density of his gas disagreed with those of methyl fluoride made by the methyl sulphate and the silver fluoride-methyl iodide methods. We did not use these latter methods in our work, as we considered it unlikely that pure methyl fluoride could be obtained in these ways. By diffusion, Gonzalez failed to show the presence of an impurity in the purified methyl fluoride made by Collie's method. On general grounds, it is unlikely that methyl fluoride and methane would form a constant boiling mixture. It appears to us that the experimental evidence points to the fact that Gonzalez obtained pure methyl fluoride, whilst the other methods lead to an impure product. This view is supported by the fact that the gases made by Moles and Batuecas by the methyl sulphate and the silver fluoride-methyl iodide methods show differences in mean density amounting to 0.006 in the atomic weight of fluorine.

In conclusion, we may say that we do not wish to stress unduly from our own preliminary experiments a value of  $F = 19.01$  rather than  $F = 19.00$  for the atomic weight of fluorine. The chemical evidence at present available, however, appears to point to the higher value. The question can only be settled by further experiment.

H S PATTERSON  
W CAWOOD  
R WHYTELAW-GRAY

University, Leeds,  
Jan 20

<sup>1</sup> NATURE, 128, 966, Dec 5, 1931

<sup>2</sup> J Amer Chem Soc, 34, 592, 1912

<sup>3</sup> Annales Soc esp Fis Quim, 20, 539, 1922

#### Structure and Development of Temperature Inversions in the Atmosphere

MESSRS Mal, Basu, and Desai have discussed recently<sup>1</sup> the subject of temperature inversions with dry air above them. Their forthcoming publication, in which the effects of turbulence and radiation are discussed quantitatively, will be welcomed by meteorologists. It is, however, scarcely correct to

state that the present view implies that the discontinuity of temperature develops before that of humidity. Some years ago I discussed the prevailing ideas on this subject<sup>2</sup> (including a paragraph drawn up in collaboration with the late M. A. Giblett), and the view taken was rather that the discontinuities of humidity and of temperature develop simultaneously under the influence of a number of factors. The main emphasis was placed on the adiabatic warming of slowly descending air, with its greater effect on dry than on cloudy air, and on turbulence up to a limit which becomes gradually lower and more sharply defined. The importance of radiation in increasing existing discontinuities was mentioned, though no doubt it ought to have been stressed more strongly.

Adiabatic warming gives a simple explanation of both the warmth and dryness above the inversions, and, moreover, these inversions are found when descending air is to be inferred from divergence in the horizontal air motion. They are by no means always present above horizontal cloud-sheets. In the particular circumstances mentioned by Messrs. Mal, Basu, and Desai, namely, in the region between a retreating cyclone and an advancing anticyclone, the observed change leading up to the inversion is normally a rise of temperature above the inversion level rather than a fall below it.

If we consider inversions in all conditions, we find that a rise of temperature above and a fall below are about equally important on the average, but it must be remembered that the air is normally in motion. In the rare cases when the air is stagnant the observed changes of upper air temperature and humidity are small. It is essential to distinguish between changes at one place and changes in a given mass of air. In the case of an inversion it is sometimes necessary to follow the air masses above and below it on separate tracks, but this is by no means always so, since many anticyclonic inversions are associated with no appreciable discontinuity of wind. (For theoretical reasons this means that they are horizontal.)

At present the aerological data are insufficient for any direct quantitative investigation, and similar remarks apply to the development of clouds from haze layers. In England most dry inversions are found above strato-cumulus clouds formed initially over the sea, and the most frequent level of the inversions is at about 4000 ft in winter and 6000 ft in summer. Over land in winter there is little tendency for the formation of strato-cumulus clouds, but only of fog or very low stratus.

C. K. M. DOUGLAS

49 Oakley Street,  
London, S W 3, Jan. 22.

<sup>1</sup> NATURE, 129, 97, Jan. 16, 1932.

<sup>2</sup> Quar. J. Roy. Met. Soc., 55, p. 133, 1929.

#### Melde's String vibrated by Rotating Pulley

IN view of the fact that in the violin the bow is often held inclined to the string, it was presumed that the bow produced both a longitudinal and a transverse force at the point of contact during bowing. The vibration of the violin string would, therefore, be the superposition of the vibrations due to these two separate forces.

To test this, a Melde's string was excited by passing it over a pulley and making the pulley rotate. This gave a constant longitudinal force acting upon the string. The vibration was excited quite easily. A length of 2 metres vibrated with the fundamental having an amplitude of about 3.5 cm ( $2a=7$ ), the first harmonic had an amplitude of 2 cm nearly, the second 1 cm nearly. In the actual experiment

the horizontal rotating axle of the viscosity apparatus (method of concentric cylinders) was used for the pulley. The string was passed round this axle and tied to two screws nearly 4 cm apart. Sometimes the top string vibrated and sometimes the lower, as the tension in the two strings was adjusted. This showed that the effect was not spurious and was not due to any transverse motion of the axle. The tension away from the fixed end generally gave the lower frequencies, the tension towards the fixed end the higher ones.

The string was next passed over a smooth pulley rotating at right angles to the length of the string. The middle pulley of the step-down gear of the Callendar's apparatus for the determination of  $J$  was used for the purpose. The fixed end of the string was placed as close to the pulley as possible. The vibration could be seen to have a frequency absolutely distinct from that of the pulley, being much higher than it. The amplitudes worked up compared with the amplitudes for the longitudinal mode of excitation.

The production of continuous motion by vibration is well known. The reader may take the experiments here described as the converse of experiments discussed by Taber Jones<sup>1</sup> and by Morton and McKinstry<sup>2</sup>.

SATYENDRA RAY.

14B Hewett Road, Lucknow.

<sup>1</sup> Phys. Rev., 2, p. 150, 1918 and 27, p. 622, 1926.

<sup>2</sup> Phys. Rev., 29, p. 192, 1927.

#### Cytology of the Mycetozoa

IN reply to Miss Lister's recent communication,<sup>1</sup> I should like to raise the following points.

1. The statement concerning the spore-wall, p. 106 of my paper,<sup>1</sup> is meant to apply particularly to *Didymium nigripes* var. *xanthopus* and not generally to other members of the Mycetozoa. The complete statement is as follows: "The spore of *Didymium nigripes* is rounded to oval in shape and approximately 10 to 12  $\mu$  in diameter. The spore membrane is comparatively thin, consisting of a single dark-coloured layer, 2  $\mu$  in width, and not of two layers as stated in Lister's Monograph."

2. I do not wish to disregard the monospore cultures made by other investigators, but merely to point out that I have had difficulty myself. Indeed, I am of the opinion that there is a much greater possibility of obtaining satisfactory monospore cultures in *Didymium nigripes* var. *xanthopus* than there was in *Reticularia* (p. 126). On p. 99 I refer to Cayley's monospore cultures and express the hope that I shall be able to repeat my endeavour to isolate single spores, using her method.

3. On p. 129 I refer to the discovery of flagellate fusion in *Didymium difforme* by Cayley, but I do feel that such a conclusion should be supported by investigation of nuclear detail in stained preparations.

4. I have already apologised to Miss Cayley for having misunderstood her views concerning the connexion of sex segregation with meiosis, and am sorry that I was so much influenced by her diagram, which she admits is rather misleading.

I should like to thank Miss Lister very much for the great interest she has shown in my work, and I trust that the above will make quite clear the points she raises.

ELSIE J. CADMAN

Edinburgh and East of Scotland

College of Agriculture,

13 George Square, Edinburgh,

Jan. 26

<sup>1</sup> NATURE, 129, 131, Jan. 23, 1932.

<sup>2</sup> Trans. Roy. Soc. Edinburgh, 56, 93-142, 1931.



## Research Items

Excavations at Fara—A preliminary report by Dr Erich Schmidt on a short season's work at Fara appears in the *Museum Journal* (Philadelphia), vol 22, 3-4. Fara lies north-west of Ur. The surface of the mound was much disturbed by the Koldewey Expedition of 1902-3. Work was confined to a few test plots at points of medium height, three to eight metres above plain level. The original ground surface level was attained in one group of twin plots. Three strata or periods were distinguished. Fara III is a settlement of the time of the third dynasty of Ur (2400-2300 B.C.) which was known as Shuruppak. As the remains of Fara II begin immediately below the surface of the mound, the only evidence for the existence of this settlement in the plots investigated is that yielded by a well-built circular construction of brick which proved to be a granary of the second period filled in by debris, including a number of human skeletons, of the third period. One of two cuneiform tablets speaks of 'the year when Gmíl-Sin became king'. The most striking finds were a number of pottery figurines or 'plaques', valuable especially for the style of dress and the insignia of royalty or deity. Fara II, 'the Early Sumerian', found immediately below the surface and extending down to a sterile stratum, saw the climax of the life of the mound, when it was large and wealthy. The finds included a large number of archaic inventory tablets. Lumps and fragments of copper were found at all depths. Below the sterile layer is Fara I, 'the Painted Pottery period', comparable to Jemdet Nasr culture, with suggestions of, but as yet no very definite clue to, the earlier al'Ubaid period. Fara I has as yet provided no written records. Fara, like Ur and Kish, thus supplies evidence of an inundation, but the occurrence of pottery and seals of Fara II in association with the Jemdet Nasr levels is interpreted to mean that while the Jemdet Nasr and 'early Sumerian' cultures were independent, they yet lived side by side during the infiltration of the Sumerian and until Jemdet Nasr died out.

Inheritance of Intelligence—In a recent study of the relation between intelligence and inheritance, by Miss E. M. Lawrence (*British Jour. Psychol.*, Monograph Supplements, 16), the Stanford-Binet tests and, in certain cases, tests devised by the National Institute of Industrial Psychology, were applied to several groups of children of school age. One group is the inmates of a home for illegitimate children separated from their parents at an average age of six months, another group consists of the children in an institution which admits children who need a home for any cause, two groups were from poor law homes, and the fifth from a London elementary school. Various statistical comparisons are then made between the I.Q. of the children and the social class of the parents. One conclusion reached is that even if the child has never lived with its parents, it is likely to have a slightly higher intelligence if its parents came from the upper classes than if they came from labouring people, although there are numerous exceptions both ways. The association of intelligence with class is greater for children who remained longer in their own homes, but the intelligence of children removed from bad surroundings apparently does not improve in a good environment. All the figures show a big drop in intelligence level with age, which means that the tests for successive years are too steeply graded. Illegitimate children are not significantly more or less intelligent than others. Various other

relationships are brought out in this paper, which concludes with a bibliography of the recent literature on this subject.

Physiology of Rheumatism—Ll. J. Llewellyn and A. Bassett Jones suggest that 'rheumatism' is the result of the body's failure to adapt itself to its physical environment, or atmospheric changes in their widest sense (*Brit. Jour. Physical Medicine*, vol 6, p 181, 1931). It is well known that rheumatic subjects are abnormally sensitive to changes in the weather, moreover, rheumatism is much more prevalent in the temperate zone with its variable climate than in the frigid or torrid zones. It is probable that the sympathetic nervous system and the endocrine glands are involved in the response of the body to changes in its environment, and that some deficiency in the response of these systems is the ultimate cause of the body's failure of adaptation. Thus the response to changes in temperature largely depends on the proper functioning of the sympathetic nervous system, owing to its control of the sweat glands and the distribution of blood in the body, a high external temperature results in sweating and dilatation of the skin blood vessels, by which means the surface of the body is cooled. The skin must play an important part in this adaptation, since it is the receptor for many of the stimuli impinging upon the body, as well as being the chief site of heat loss. Now, the skin contains unusual amounts of the amino acids, tyrosine and cystine (presumably in protein combination), tyrosine is closely related to adrenaline and thyroxine, the active principles of the medulla of the suprarenal and of the thyroid glands respectively, both of which play important parts in heat production in the body, tyrosine and cystine are also constituents of insulin. The authors suggest, therefore, that ultra-violet rays, for example, can mobilise tyrosine from the skin (a process comparable to the conversion of ergosterol to vitamin D), and thus affect the supply of thyroxine and adrenaline to the tissues in general, and that rheumatism may be the result of an inadequate supply of tyrosine and cystine in the skin together with deficient exposure to sunlight.

Protective Coloration of Birds' Eggs—In the recent number of the *Journal of the Bombay Natural History Society* (October, p 250), Mr E. C. Stuart Baker describes a case discovered by Mr J. Stuart of localised protective coloration in the eggs of a ground-nesting bird, the yellow-wattled lapwing (*Lobophanes malabarica*), which, on a belt of brick-red laterite soil stretching along the Malabar coast into Travancore, lays remarkably assimilated red eggs, but earthy coloured ones on the black soil areas around. The conclusion is drawn that, as the birds increased on the black soil, some were forced to colonise the red belt, and here only such eggs as exhibited a reddish tinge could escape vermin, so that in the course of generations the red protective type was evolved. In view of the well-known proneness of eggs to mutation, a simpler explanation would seem to be that the birds originally bred indiscriminately over the whole area, that some red egg-laying mutants were always present, and that these only could maintain themselves on the red soil belt.

Yagé, a South American Drug Plant—Extensive collections of Indian drug plants made by Mr Guillermo Klug, of Iquitos, Peru, in the Putumayo region of south-eastern Columbia, include three species of *Banisteriopsis* (family Malpighiaceae). These plants are known by the Indians under the general name of 'yagé', and they are boiled until

a syrup is produced. To this is added leaves and young shoots of a particular species of the genus, and to this is attributed the 'blush aureole' seen by the Indians in the state of anæsthesia into which they fall after drinking the liquor. The liquor appears to excite the cerebral centres of vision, and it is stated that, as a result, their sensibility is so developed that after drinking yagé a person is capable of "seeing objects in the midst of the most complete obscurity." Mr Klug was also informed that this drink was a very effective cure for malaria. Specimens from Mr Klug's collections have now reached the United States National Museum, and Mr C. V. Morton has described a new species (*J. Wash. Acad. Sci.*, vol 21, No 20, 1931), with notes on the action of the drug supplied by Mr Klug.

**Composite Nature of Potato Virus Diseases**—Dr Kenneth Smith, in his recent paper "On the Composite Nature of Certain Potato Virus Diseases of the Mosaic Group as revealed by the Use of Plant Indicators and Selective Methods of Transmission" (*Proc. Roy. Soc. B*, 109, pp 251-267, see also *NATURE*, 127, 702, May 9, 1931), has brought good evidence to show that the mosaic, crinkle, and streak diseases of potatoes are each caused by more than one virus. The aphid *Myzus persicae*, Sulz., will not carry any of the diseases mentioned as a whole, but only one or more of the component viruses. Plant indicators, such as tobacco, are also used, for when a composite mosaic is inoculated on them they show different symptoms if more than one virus is concerned. Plants of *Datura Stramonium* and *Petunia* are susceptible to one of the viruses, but not to the others. It is also found that the component viruses have different incubation periods and different rates of transmission within the host plant. This also can be used to separate them. Two viruses, named provisionally *x* and *y*, have been isolated from a symptomless 'streak'-carrying potato (Up-to-Date), and *y* seems to be a widespread component of potato virus diseases. The work here reported should go far towards standardising our knowledge of the diseases which cause the so-called potato 'degeneration'.

**Reactions of Horizons in Tropical Soils**—This subject is discussed in relation to the soils of Nyasaland by A. J. W. Hornby in a letter in *NATURE* for Jan 9, p 58. It is also one of the many interesting points dealt with by D. S. Gracie in a pamphlet on "A Preliminary Survey of Some of the Soils in Kenya" (*Bull.* 1, 1930, Dept. Agri., Kenya). These surveys were carried out on a profile basis to a depth of five feet, for it was realised—and the importance of the point clearly demonstrated in the course of the work—that although the surface layers are the more intimately connected with the crop, yet subsoil conditions may necessitate considerable modification of conclusions derived from a study of the surface layer alone. Instances are cited where the acidity increased continuously with depth, but no indication of these undesirable conditions was shown in the surface soil, the agricultural value of which, however, was seriously affected. Soil colour is also intimately associated with soil fertility, for removal and redepositions of iron, which are closely correlated with the degree of acidity and the amount of humus that is lost, are accompanied by changes in the colour of the soil. Another factor of fundamental importance is the nature and amount of organic matter present. This is found to be, under natural conditions, a function of the exchangeable calcium, the degree of acidity, and the climate, for acidity or lack of available calcium arises from lack of suitable organic material. That climatic conditions also play a part is well brought out by a comparison of the humus content of

soils (similar as regards exchangeable calcium and pH value) from different altitudes. Throughout the survey the practical aspect, that is, the value of the soil to the agriculturist, has been kept in the foreground, and a section of the bulletin is devoted to a discussion on the improvement and maintenance of the fertility of soils of different derivations.

**Algal Origin of Petroleum**—An important paper to those interested in the biochemical aspects of petroleum genesis was communicated to the Institution of Petroleum Technologists on Jan 12 by Mr J. E. Hackford. As he rightly points out, the origin of oil from decomposition of marine vegetation is a generally accepted thesis in many cases, but the precise mechanism of the chemical actions involved has lacked detailed investigation. In practically all accounts of the organic origin of petroleum, the geochemical processes contributing to its formation are stated with almost convincing logicity, but the mist becomes nearly impenetrable when information is sought as to the manner in which organic debris gradually changes into the oily globule and the precise chemical circumstances involved. The author claims to have established the formation of oil from algae by processes similar to those obtaining in Nature, the presence of decomposition products of algae in both naturally occurring oils as obtained from wells and also from seepage oils and bituminous deposits, the reconversion of oils into materials closely resembling, sometimes identical with, the constituents and decomposition products of algae, the formation of oils from sugars, and the reconversion of oils into bodies resembling bitumens which upon hydrolysis yield sugars. The work as a whole supports the algal theory of the origin of some classes of petroleum, and goes further than this: that oil and bitumen are in the main produced from the sugars resultant upon the hydrolysis of algae. From this, the author concludes that the vegetal theory of origin should be renamed "The Carbohydrate Theory of the Origin of Oil." This is one of the most interesting, if not provocative, papers presented to oil technologists for some time past, and the conception of the fucose-petroleum cycle, as it is called, constitutes a welcome advance in this difficult domain of biochemistry.

**Nature of the Carbon Dioxide Molecule**—It has been suggested from the way in which the specific heat of carbon dioxide alters with temperature that it exists in two forms, one straight and the other slightly bent, but conflicting results for the dielectric constant have made it impossible to decide from this if the bent form, which should have a permanent dipole moment, does actually exist. T. L. Ibbs and A. C. R. Wakeman have recently described a series of experiments on the thermal diffusion of carbon dioxide in gas mixtures, and on its viscosity, which seem to decide the point at issue (*Proc. Roy. Soc.*, Jan). With both phenomena it has been found that sharp changes occur in the curves connecting the numerical measure of the effect with the temperature, at about 140°C. In the case of diffusion, the transition temperature is 146° for a hydrogen mixture and 144° for a nitrogen mixture. This change is described by saying that the carbon dioxide molecule is 'hard' above 145° and 'soft' below this temperature. In the case of the viscosity, the change occurred at 140°, in excellent agreement with the results of other experimenters. From a discussion of these and other data it is suggested that the 'soft' and 'hard' modifications have, respectively, the straight and bent structural formulæ.

**Hydrides of Boron**—The preparation of the hydrides of boron by the usual method of the interaction

between an acid in aqueous solution and an alloy of boron gives very poor yields and is long and tedious. Schlesinger and Burg have described (*J. Amer. Chem. Soc.*, Dec 1931) a method for the preparation of diborane,  $B_2H_6$ , which consists in the reduction of gaseous boron trichloride by hydrogen in an electric arc discharge at low pressure. Boron, various non-volatile hydrides and large yields of an unstable spontaneously inflammable substance, considered from its reactions to be  $B_2H_5Cl$ , are also formed. The last-named compound, however, on warming decomposes and gives a further quantity of diborane  $6B_2H_5Cl = 5B_2H_6 + 2BCl_3$ . When diborane containing a small quantity of hydrogen chloride is heated at  $120^\circ$ - $130^\circ$  a considerable proportion is converted into the more stable pentaboron hydride  $B_5H_9$ .

**Aromatic Nitroso-Compounds in Solution**—The apparent molecular weights of nitrosobenzene and a number of its derivatives were determined in dilute solutions, mostly in benzene, by Bamberger and co-workers, and the results seemed to indicate that the state was unimolecular. Hammick has shown that these results are ambiguous, and has described new experiments with co-workers on nitrosobenzene and several substituted products (*J. Chem. Soc.*, Dec 1931). The results show that nitrosobenzene itself and its meta- and para-derivatives are associated in dilute solution. In the case of mono- and di-ortho-substituents a steric effect was detected. The degree of association of nitrosobenzene itself is quite small, about 2.4 per cent, but in some of the derivatives large associations were found, such as 38.2 per cent for o-nitronitrosobenzene and 77.3 per cent for nitroso-mesitylene. In the di-ortho-substituted derivatives

there is enormously enhanced stability of the bimolecular form. The first step in association in the case of nitrosobenzene is thought to be dipole association, although it is considered unlikely that the bimolecular forms of nitroso-compounds are simply dipole aggregates, and the dipole aggregate is thought to pass into an oxyazoxy-structure.

**A Compound of Nitrobenzene and Sulphuric Acid**—A compound,  $C_6H_5NO_2 \cdot H_2SO_4$ , separates on cooling an equimolecular mixture of the two components, the melting point,  $11.6^\circ$ , being higher than that of either component. Masson has published (*J. Chem. Soc.*, Dec. 1931) a complete freezing-point diagram for the two substances, which shows a well-defined maximum corresponding with the equimolecular compound and two eutectics, so that probably this is the only compound formed. The compound forms colourless needles at low temperatures, but at room temperature is an oily liquid which is surprisingly sluggish towards water and does not liberate much heat when decomposed by it. In sulphuric acid it forms solutions which conduct better than the acid alone, so that the compound is regarded as an electrolyte  $(C_6H_5 \cdot NO_2 \cdot H)^+ (HSO_4)^-$ , the hydrogen ion or proton being co-ordinated with one of the oxygen atoms of the nitro-group. The attachment of the positive hydrogen ion to the nitro-group should promote meta-substitution in the same way as happens with an arylammonium ion. The stability of the compound suggests, indeed, that in the dinitration of nitrobenzene it may well be the positive nitrobenzene-hydrogen ion, rather than the neutral nitrobenzene molecule, which is the main organic reagent and thus the source of the preponderating meta-derivative.

### Astronomical Topics

**Reinmuth's New Object**—Dr Kahrstedt has published elements of this object in *Rech. Inst. Circ.* 534, as follows:

|          |                      |
|----------|----------------------|
| T        | 1933 Oct 28 2854 U T |
| $\omega$ | $96^\circ 34' 0''$   |
| $\Omega$ | $45 \ 46 \ 21$       |
| $i$      | $31 \ 14 \ 21$       |
| $e$      | $0.1624184$          |
| $\log q$ | $0.6578513$          |
| Period   | $12.65425$ years     |

The orbit is still very uncertain, the arc being short. The object appears to be of the same type as comet Schwassmann-Wachmann (1), but with a somewhat smaller orbit that comes inside that of Jupiter at perihelion. The orbit makes a near approach to that of Jupiter at the descending node. The above circular gives an ephemeris for February and March, but as the comet is fainter than mag 15, it is not given here.

*Rech. Inst. Circ.* No 540, dated Jan 30, states that Prof M. Wolf has changed his opinion about the object, and no longer considers that it is nebulous; it may, therefore, be a minor planet, not a comet, but even in this case it deserves attention, as its orbit appears to be of an unusual type.

**The Light Variation of Cepheids**—*Meddelande* of Lund Observatory, Series I, No 128, contains a study by Dr K. Lundmark of the correlations between period and magnitude and between period and amplitude of light-change in the Cepheid variables. He includes in his study the stars in the Magellanic Clouds, the nearest two spiral nebulae, the globular clusters, also galactic Cepheids. Graphs are given for the Cepheids in all these different regions, they agree in showing a close correlation between magnitude and logarithm of period, when the maximum

magnitude is used, there is greater departure from a linear graph when the minimum magnitudes are used. There are also clearly recognisable correlations between amplitude and magnitude, but the graphs are more curved. It is noted that Dr Hertzsprung found little trace of this last correlation in the stars near Eta Carinae, but probably the stars that he was discussing were at very different distances.

Dr Lundmark uses his adopted curves to obtain new estimates of the distances in light-years of the various objects, of course, they do not differ much from those already published. He finds for the Greater Cloud 95,000 light-years, for the Lesser one 112,000 light-years, for NGC 6822 690,000 light-years, for the Andromeda nebula 840,000 light-years, for Messier 33 860,000 light-years, the distance between the last two objects would be 224,000 light-years.

*Rocznik Astronomiczny*, Cracow Observatory.—No 10 of this annual publication, edited by T. Banachiewicz, contains the ephemerides of variable stars which the above observatory undertook to compute, with the aid of grants from the I. A. U. and the Polish Minister of Education.

It includes 44 eclipsing variables with period less than  $18^d$ , 219 with period between  $18^d$  and  $10^d$ , and 26 with periods exceeding  $10^d$ . Elements, but not ephemerides, are given for 32 other stars. The ephemerides are heliocentric. For reasons of economy, stars south of Decl  $-23^\circ$  are omitted this year, also the index of ephemeris-stars.

The volume also contains certain coefficients for calculating precessions and the times of occultations of stars by the moon for five observatories in Poland. The explanations, and the headings of tables, are in flexible Latin, which is easy to read.

## Research on Springs \*

THERE are few people at the present time who are not interested in springs of some kind. That large section of the general public which uses the automobile, either for business or pleasure, generally finds at some time or other that the breakage of a circular spring round a valve stem or of a flat spring on the suspension system may be responsible for an amount of inconvenience out of all proportion to the seriousness of the accident.

Even government departments are liable to such troubles, and both during the War and for some years after, the Chief Inspector of Mechanical Transport of the War Office directed attention to the unsatisfactory position in relation to the design and performance of laminated springs for mechanically propelled vehicles. Failures of valve springs in aircraft engines were reported by the Air Ministry, and both the Admiralty and the War Office were experiencing difficulties with spiral springs. In the motor-car trade there was much trouble associated with the use of valve springs on high-speed car engines and generally where the working conditions were severe.

Due to the representations made to the Department of Scientific and Industrial Research, a Springs Research Committee was appointed in 1922, with the main object of carrying out such inquiries and researches as would result in the improvement of the materials and design of laminated and spiral springs. Since that time much work has been done by the different sections of the Committee, and the results of their investigations have been published from time to time. In the Report just issued, a general survey is made of the whole of the Committee's work and the definite conclusions to be drawn from it are summarised.

It will be found that the field covered by the Com-

mittee is a very wide one. Naturally the researches into the properties of spring material bulk largely in the Report, but much work has also been done in perfecting methods of testing complete springs and of finding the oscillating and loading conditions to which springs are subject under road service.

The most striking conclusion reached is that, with springs as ordinarily manufactured and used, the high stress-resisting properties of which the spring material is capable are not realised. Spring material of many types has been tested under a wide variety of conditions, and has shown itself to be capable of resisting wide ranges of repeated stress for long periods. When, however, this material is converted into springs, breakage occurs at stress ranges of from about one-quarter to one-half of what should have been resisted.

The explanation given for this surprising discrepancy is that a surface weakness is developed during the heat treatment and other manufacturing processes. Experiment has shown that this deleterious surface layer is very thin, and that the full resistance value of the material can be regained by machining about one-sixteenth of an inch from the surface of the spring. With spring steel wire the same conclusions hold, in all grades of wire tested the 'surface effect' was evident even when the wire had been manufactured under special conditions. It is, therefore, not surprising that the Committee recommends that manufacturing methods should be developed for the production of spring steel in plates or wire which shall utilise the full intrinsic fatigue strength of the material.

The Report should be of value both to the user and manufacturer of springs. It is an excellent illustration of the value of co-operation between science and industry, since, largely as a result of a systematic and detailed programme of research, both an explanation and a remedy have been found for a trouble responsible in the past for many serious consequences.

\* Department of Scientific and Industrial Research. Report of the Springs Research Committee. Pp. iv + 75 (London: H.M. Stationery Office, 1931) 1s. 3d. net.

## The Dating of Pueblo Ruins in Arizona

EXCAVATIONS undertaken on four sites in Arizona, Kin Tiel and Kokopnyama, north of the Little Colorado River, and Pinedale and Showlow in the forested area to the south, have furnished evidence which will now make it possible to date the phases of Pueblo culture with accuracy over a period of 1200 years.

The researches in dendro-chronology, as applied to Pueblo archaeology, which were undertaken by Dr. A. E. Douglass at the invitation of the National Geographic Society while the famous ruins of Pueblo Bonito were under excavation by one of its expeditions, have established two sequences of ring records in the course of three 'Beam Expeditions' to the Pueblo area.

For one of these the coincidence and overlap of the annual rings in pine log beams from the still inhabited Hopi village of Oraibi were worked out, in accordance with the system elaborated by Dr. Douglass, from the normal and subnormal growth of rings according to rainfall, to show a complete historical sequence back to about A.D. 1260. By the same method a prehistoric sequence was established, extending back over 580 years on the evidence of beams from the Citadel ruins at Mesa Grande and Pueblo Bonito, thus going back into the third of the five periods of Pueblo culture, of which the fifth and last extends from the Spanish conquest in the sixteenth century to the present day.

The excavations at the four sites mentioned were undertaken in the hope of finding a link which would connect the prehistoric and historic sequences and substitute an absolute dating for the relative dating of the earlier period. It was thought that such a link would be provided by the study of a certain transient type of Pueblo pottery, for which no date was available, but which, it was thought, would furnish a clue to ruins immediately antedating the still inhabited Oraibi village. A reconnaissance of twenty prehistoric villages was made before the four sites in question were selected.

The accounts of the chronological and archaeological results obtained by Dr. Emil W. Haury and Mr. Lyndon Hargrave at Showlow and Pinedale, and by the latter at Kin Tiel and Kokopnyama (*Smithsonian Miscellaneous Collections*, vol. 82, No. 11), provide some indication of the far-reaching effect of the application of an absolute and accurate chronology to the investigation of Pueblo antiquities. So far as the main objective of the expedition is concerned, timbers were recovered which linked together the two date sequences and carried back the tree ring calendar to A.D. 700. A beam, to which the field notation H.H. 39 has been given, was found at Showlow which proved the key beam converting the relative dating into an absolute chronology. The outer rings could be read at about A.D. 1380, while its central ring dated at A.D. 1237. The innermost rings coincided with the

last rings of the prehistoric chronology and the outer rings were readily identifiable with the thirteenth and fourteenth century records of the historic sequence. Further excavations yielded more logs which confirmed the record of the key beam.

As the last rings of any given beam give the cutting date, when it shows the true outside, it is obvious that it also gives an approximate date for the erection of the building in which it was used, provided there is no evidence of re-use. Thus at Showlow it was possible to reconstruct the history of the building. The beams showed a period of reconstruction at about A.D. 1380, with periods of activity at 1204 and 1272, while re-used beams gave dates ranging from 1175 to 1356.

The manner in which the archaeological and chronological conclusions confirm and supplement one another is well illustrated in the reports of the investiga-

tions. There are, for example, three horizons which are dated respectively at A.D. 1204 (Showlow), 1290 (Pinedale), and 1375 (Showlow), and the sequence of the styles of pottery associated with each is confirmed. The chronological evidence indicates the length of time by which culture features survive in a marginal area while dying out in the centre of origin. Thus Chaco traits are shown to exist in the pottery a hundred years after the Chaco Canyon culture ceased to exist. Further, it confirms the views of those who argued on the basis of stratigraphy that lead glaze existed in the Pueblo culture before the advent of the Spaniards, as against those who maintained that it was improbable that it could have been used by the Pueblo potters in the prehistoric period. Dendrochronology shows that it was employed fully two hundred years before the arrival of the Conquistadores.

### The Climate of Japan

IN the *Bulletin of the Central Meteorological Observatory of Japan*, vol. 4, No. 2, Prof. T. Okada gives a very thorough discussion of the climate of Japan. It is divided into three sections, entitled, "Climatography", "Climatology", and "Climatic Tables".

The first section opens with an interesting discussion on general lines of the main features of the climates of the different climatic zones into which the country can conveniently be divided, and outlines the main factors that are responsible for the primary characteristics of these. Each region is then discussed in greater detail. In the second section the method of arrangement is not geographical, but according to each climatic element—for example, air temperature, wind direction and speed, rainfall, and so on. The last section is entirely occupied with tables showing the seasonal variation of different elements, it is followed by a general index, and then by thirty-five plates setting out graphically the seasonal or geographical variations of the elements discussed earlier in the work. The magnitude of the work and the wealth of detail that it gives about a region where the organisation of climatological work on modern lines has naturally been undertaken at a later date than in Europe make it indispensable as a work of reference for professional meteorologists.

The climate of Japan, owing to the peculiar situation of that country, at no great distance from those parts of Asia which present the greatest contrasts between summer and winter to be found anywhere in the world, is a particularly interesting one; it provides an example of what Okada describes as "an extreme climate characteristic of a continent" in spite of its insular position. The winter is dominated by the prevalence of cold air flow from China. This flow does not take place across a sufficient width of sea for the latter to have very much tempering effect, but although the wind is often very strong, there is time

enough for the air to acquire a considerable amount of water vapour, and this tends to condense when the air ascends to pass across the land. The result is that "gloomy weather with snowfall prevails on the side facing the Japan Sea, and rain showers occur almost every day in the Ryūkyū or Loochoo Islands and northern Formosa. Therefore, on this side of Japan proper, snow lies deep on the ground and a thick veil of clouds overcasts the sky. Fine days are phenomenal." On the Pacific side, however, fine weather generally prevails at this season. In the islands to the south of Japan proper the influence of the Asiatic winter monsoon is overshadowed by that of the warm ocean, and luxuriant tropical vegetation can flourish.

During the summer, when the Asiatic area of high pressure disappears, to be replaced by relatively low pressure and a complete change of wind circulation, an inflow of air takes place, which crosses Japan mainly from between south and east; it is feeble and less constant than the winter monsoon, especially during the principal rainy season called the Bai-u, which comes in late June and early July. These winds do not give rise to the contrasts of climate on the windward and leeward sides of the islands found in winter, nor is there so much variation of temperature with latitude; the result is a generally hot and humid climate, appropriate to maritime conditions in those latitudes.

In conclusion, some reference must be made to a very noticeable feature of all except the southern sea-dominated parts, and that is the shortness of the spring and autumn seasons. In the north, snow may still be lying early in May, although June generally brings the heats of summer; autumn does not extend much beyond the month of October, for the cold winter winds are usually well developed by November.

E. V. N.

### Weather Forecasting

IN his Friday evening discourse at the Royal Institution on Feb. 5, Dr. G. C. Simpson discussed weather forecasting. In 1859, Admiral FitzRoy, who was then the head of the department of the Board of Trade which had recently been established to study marine meteorology, commenced to collect weather reports by telegraph from a number of ports in the British Isles, and so a new science was created and a new term added to the English language. FitzRoy's innovation was not approved by scientific men, and on his death in 1865 forecasting ceased.

The public had, however, found the forecasts useful, and considerable pressure was brought to bear on the Meteorological Office to recommence the forecast service. A new attitude was possible owing to the introduction of the synoptic chart showing the distribution of pressure by isobars, the lines with which we are now so familiar on the published weather maps. It had been found that isobars could be classified in a number of types of which the most familiar are the cyclone and the anticyclone. This remained the basis of forecasting until the War, and it is still largely

employed. The method is entirely empirical and needs no knowledge of the physics of the atmosphere.

We now recognise that weather is produced by the bringing together of great masses of air from polar and tropical regions by the general circulation of the atmosphere. Such masses of cold and warm air do not readily mix, but overrun or undercut one another along 'fronts' which can be traced for hundreds of miles on the synoptic charts. The recognition of fronts has given the forecaster a powerful new tool for the study of what is actually taking place in the atmosphere, and has greatly improved the short period forecasts, especially those for aviation.

A synoptic chart which extends only over a single country is not of much value for forecasting, it is necessary to know the weather conditions over a much larger area. To meet this need there is very close international co-operation between the official weather services of the different countries. At certain specified times each day observations are taken at forty-five stations in the British Isles and on a number of ships on the Atlantic and telegraphed to London.

The same procedure is taking place in every other country. The meteorological office in Paris takes in these national messages from countries in western Europe, and the German meteorological service does the same for central and northern Europe, while Moscow deals with the whole of the great area of the U.S.S.R. Paris, Hamburg, and Moscow then reissue the messages they have collected from wireless stations sufficiently powerful to be heard all over Europe, according to a programme carefully drawn up by an International Committee. In this way information from more than five hundred stations in an area extending from Spitsbergen and Greenland in the north to Morocco, Algeria, and Egypt in the south, and from the middle of the Atlantic in the west to Russia and Palestine in the east is available in every meteorological office in Europe within two hours of the time at which the observations were taken. The whole programme of collecting and disseminating the observations is repeated three times a day by most countries, at 7 A.M., 1 P.M., and 6 P.M. G.M.T., and a certain number of countries add another set of observations at 1 A.M.

Unfortunately, no method has been found for expressing the success of weather forecasts by giving the percentages of failures and successes, but those who have to examine every day's weather in the light of yesterday's forecast know that there has been an appreciable increase in the accuracy of the forecasts and also in the amount of detailed information it is possible to include in them.

### University and Educational Intelligence

CAMBRIDGE—Prof P. Debye, of the Physical Institute at Leipzig, has been appointed Scott lecturer for the year 1932.

Dr E. B. Worthington (Balfour student) will lecture on Feb. 17, at 5 P.M., in the zoological lecture room, on the "Great Lakes of Africa".

A COURSE of eight bi-weekly lectures on the "Optical Principles of Television" will be given by Dr W. D. Wright at the Imperial College of Science and Technology, South Kensington, London, S.W.7, on Tuesdays and Thursdays at 4 P.M., commencing on Feb. 23. Further information can be obtained from the Registrar of the College.

THE Council of the University of Melbourne has passed a resolution expressing to Mr F. Chapman,

Commonwealth palaeontologist, on his retirement from the position of part-time lecturer in palaeontology after twelve years' service, its thanks for the help which by his wide knowledge and great experience of palaeontology he has rendered to the Geological Department of the University.

EDUCATION during the past ten years in Porto Rico is reviewed in a leaflet recently issued by the U.S. Office of Education, Washington. The review is of more than local interest by reason of the description it contains of a seemingly successful experiment in rural education of a vocational type. Thirteen consolidated rural schools have been established for pupils aged eleven years and upwards, for whom the education hitherto provided in the fourth and higher grades in Porto Rican schools offers but little hope of increasing their earning capacity. In these new 'second-unit' schools only half of the day is devoted to academic subjects, the other half being given up to vocational work, namely for the boys, agriculture, animal husbandry, woodwork, house-wiring, tin-smithing, auto-mechanics, shoe-repairing, hair-cutting, clay work, and toy-making, for the girls, cooking, sewing, and hand and machine embroidery and lace-making, and for both, hand-weaving. Agriculture is a required subject for all boys and home economics for all girls. The boys raise a large variety of vegetables, which are sold or consumed in the school lunch-room, one-third of the cash value of produce sold being given to the boys who raised it. The children are encouraged to cultivate home gardens, of which there are more than 15,000. As a result of this system the quantity and quality of fresh vegetables available to the rural communities have improved and family incomes increased. The boys are taught also to plant the principal crops and to raise pigs, chickens, rabbits, pigeons, and goats. The breeds are being rapidly improved. The lessons in cooking aim at a diet based largely on Porto Rican produce, and the results are tested in the school lunch-room. It is noteworthy that this experiment, which is one of the fruits of an educational revival brought about by a survey conducted in 1925 under the direction of Dr Paul Monroe of Teachers' College, Columbia University, was undertaken during a period of severe retrenchment in educational expenditure.

### Calendar of Geographical Exploration

Feb. 16, 1623—Arnhem Land

Jan Carstensen on an expedition in which two ships, the *Arnhem* and the *Pera*, took part, sighted the snowy mountain chain of central New Guinea. Mt Carstensen, more than 15,000 feet in height, takes its name from him. The two ships became separated. Carstensen in the *Pera* discovered and named several rivers in the York peninsula. Although the lands discovered by the *Arnhem* are not exactly known, the vessel explored the region between 9° and 13° S in that part of the Northern Territory, Australia, now known as Arnhem Land.

Feb. 16, 1816—The Congo Cataracts

Capt Tuckey, with a party which included a botanist, a geologist, a naturalist, and a comparative anatomist, left England commissioned by the Government to ascend the Congo. Another party was sent to the Niger, and it was hoped that the two might eventually meet, Mungo Park's explorations having failed to clear up the question of the separate identity of the Niger and the Congo. Tuckey's party reached the first cataract of the Congo and thence attempted



exploration by land. Disease, however, overtook the party and they returned to the ship, where Tuckey and others died. The companion expedition, which had landed on Dec 14 at the mouth of the Rio Nunez, midway between the Gambia and Sierra Leone, met with equal disaster, disease and discord with the natives resulting in the death of most of the party.

#### Feb 18, 1865 —Colonel Pelly in the Nejd

Colonel Lewis Pelly, British resident at Bushire, set out from Koweit with a small caravan, and after five waterless days in the desert reached the wells of Orma at the foot of Jabal Tueik. On March 5 he reached Riyadh. On the return journey the guide led Pelly's party by a route considerably to the north of Hofuf, all the main lines of relief were found to run north and south, and seven distinct ridges had to be crossed in the descent from the Tueik plateau to the coast. He covered some previously unexplored regions, but was unable to take as many measurements and observations as he had hoped owing to the need for haste in view of political difficulties. Pelly was the first representative of a European government to venture into the centre of the Arabian peninsula openly avowing the nature of his mission.

#### Feb 20, 1844 —Between the Mississippi and the Pacific

J C Frémont, one of the greatest of American explorers, reached the summit of the snow-covered Sierra Nevada mountains. He had started out in 1842 to explore the route beyond the Mississippi as far as South Pass in Wyoming. He ascended the second highest peak of the Wind River mountains which now bears his name and in the following year reached the Oregon settlements. Thence he turned south and east via the Klamath lakes to north-western Nevada and the Truckee and Carson rivers, covering much previously unexplored country. After crossing the Sierra Nevada he spent the rest of the winter on the Sacramento River, and returned round the southern end of the range to the Great Salt Lake, following the old Spanish trail from Santa Fé to California. Frémont had accompanied J N Nicollet, the French explorer, in his survey (1835-40) of the country between the upper waters of the Missouri and Mississippi rivers. In 1841, Frémont headed an expedition to the Des Moines River and thus completed Nicollet's map. His explorations opened up a great part of the country between the Mississippi valley and the Pacific Ocean. Frémont had a varied career, afterwards becoming soldier, politician, and multi-millionaire.

#### Feb. 20, 1848 —Northern Arabia

G. A Wallin, a distinguished Arabic scholar, who afterwards became a professor in the University of Helsingfors, left Muweila on the second of his famous journeys in northern Arabia, travelling disguised as a learned Arab sheik. Striking inland across the unexplored granite mountains, he reached Tebuk, an ancient village on the Syrian pilgrim route. Thence he proceeded to Tema, crossed a tongue of the Nafud, and after a month's stay at Hail accompanied a party of tribesmen to Meshed Ali and returned via Bagdad. On a previous journey Wallin had started from Cairo and travelled via Maan over the Hamad to Jauif. Thence he had crossed the Nafud, seen the isolated grey granite chains of Jabal Aja and Jabal Selma, and penetrated to Hail. Of Medina and Mecca which he also visited he left no detailed account. Although he took no instruments, his full and minutely accurate reports gave a clear picture of the regions through which he passed, many of them never before visited by a European.

## Societies and Academies

### LONDON

Royal Society, Feb 4 —J R Baker and R. M Ranson. Factors affecting the breeding of the field mouse (*Microtus hirtus*)—(1) Light. The shortening the daily period of exposure to light from fifteen hours to nine hours almost stops reproduction in the field mouse, *Microtus hirtus*. The female is chiefly affected—T. H Bissonnette. Modification of mammalian sexual cycles, reactions of ferrets of both sexes to electric light added after dark in November and December. Male and female ferrets were subjected to doses of electric light during the night between October and January. Full œstrus was induced in the females in 38-64 days and successful coitus in 59-70 days. In the males interstitial cells were stimulated and copulation took place in 59 days, but no mature sperms were found even after 71 days. Birds differ from mammals in that the males are more responsive to doses of light than females. It is suspected that, with both birds and mammals, light may act through modifying anterior lobe activity, or susceptibility to it—R N Salaman. The analysis and synthesis of some diseases of the mosaic type. The problem of carriers and auto-infection in the potato. As a result of both analytical and synthetic methods it has been possible to ascribe compositions in terms of X, Y, and Z to certain definite clinical virus diseases. The reaction of a virus complex is not the mere summation of that of its two constituents, but rather a linked group the strength of which varies according to the complex and the internal environment of the plant. At times a complex may break up either in an infected or a carrier plant, and one or other element becomes recognised as such. If this takes place in a carrier plant it is known as auto-infection—C. C John. The origin of erythrocytes in herring (*Clupea harengus*). During the first five months of development, the herring is devoid of red blood. The demersal egg hatches into a tiny larva in which the heart is at first a simple two-walled tube divided into two parts by a narrow constriction in the middle. The vascular fluid is colourless and does not contain any corpuscles. From deep water the larva migrates into mid water, and later to the coast. During this period the endocardium develops into a syncytial sponge-work in which numerous large nuclei develop, these ultimately migrate to the surface of the sponge-work and bud off into the vascular fluid as mother-cells of the red-blood corpuscles. At the 35 mm. stage the larva is at first rather opaque and the blood is colourless. When metamorphosis starts, a silvery sheen appears on the dorsal surface, and the body becomes opaque and the blood commences to turn red. A similar condition occurs during the development of the eel, in teleosts in general the blood originates from the intermediate cell mass during the early embryonic stage, but in herring the hæmocytopoietic function is confined to the endocardium until the spleen develops.

Physical Society, Dec 4 —C F B Kemp. Some properties of the sound emitted by airscrews. A condenser-microphone amplifier system has been employed to determine the intensities and directional properties of the first six harmonics in the sound of rotation of an airscrew operating at zero rate of advance and actuated by a silenced engine. The sound-energy associated with the frequencies considered is 18 watts, the fundamental (first harmonic) being responsible for 50 per cent of this, while the first three harmonics together contribute 90 per cent.

Maximum intensity occurs at  $15^{\circ}$ - $30^{\circ}$  behind the plane of rotation, and in this region the sound-output is particularly steady. Large intensity-fluctuations occur along the axis of the slip-stream. The intensity follows the inverse square law of distance at points farther than 200 ft from the airscrew centre, a 2.4-power law holding approximately for nearer points.—J H Awbery and Ezer Griffiths. The basic law of the wet-and-dry-bulb hygrometer at temperatures from  $40^{\circ}$  to  $100^{\circ}$  C. The relative humidity was measured both by absorbing and weighing the moisture in a known volume of air and by the dew-point method. The results are finally expressed by means of a skeleton table for the wet-and-dry-bulb hygrometer in the temperature range referred to.—J H Awbery. The water-content of saturated air at temperatures up to  $100^{\circ}$  C. The water-content of air which is just saturated has been measured at temperatures from  $29^{\circ}$  to  $94^{\circ}$  C by absorbing the moisture and weighing it. To obtain saturation, air was bubbled through water in a thermostatically controlled bath. In some experiments the air was initially below saturation, whilst in others it was not and contained more moisture than would be necessary for saturation at the bath temperature.—Ezer Griffiths and J H Awbery. (1) The specific volumes of some gaseous refrigerants, (2) the latent heat of some refrigerants. The method used consists in permitting the liquid to evaporate repeatedly into an exhausted vessel so that automatically the vapour is under saturation pressure. The volume of the vessel is known, and the weight necessary to fill it is found from the decrease in weight of the liquid. The substances studied were sulphur dioxide, dichloroethylene, ether, pentane, and trichloroethylene. The latent heats of evaporation of ethyl chloride, methyl chloride, sulphur dioxide, pentane, and dichloroethylene have been measured over the temperature ranges lying between  $-18^{\circ}$  C and  $+25^{\circ}$  C. The method used is an electrical one, in which a known amount of energy is supplied at constant temperature and the mass evaporated is obtained by weighing.

## EDINBURGH

Royal Society, Jan 11.—Sir E. A. Sharpey-Schafer and W A Bain. The employment of intra-cardiac injections of adrenaline in asphyxia. In asphyxia caused by occlusion of the trachea, intra-cardiac injection of adrenaline has a marked effect in promoting recovery of the circulation. Even if the heart has ceased to beat for a short time, it will contract strongly and rapidly as the result of such injection, which should be made through the chest-wall, directly into the heart muscle. The adrenaline not only affects the heart but also the arteries, causing them to contract and thus keeping the blood pressure raised. Breathing recommences as soon as the circulation is restored, and although at first slow and deep, the respiratory movements gradually resume their normal character. The effects of the adrenaline injection are assisted by artificial respiration produced by intermittent pressure on the abdomen and lower part of the thorax.—B P Wiesner and Miss N M Sheard. Studies on maternal behaviour and its endocrine basis. Maternal behaviour in the albino rat can be prolonged by regularly replacing grown-up litters by small ones. The stimulus value of young with respect to maternal responses is inversely proportional to the age of the young. Determination of the age of the oldest young which is still retrieved by a female represents a method for evaluating the intensity of the retrieving drive. Oophorectomy before or after parturition does not interfere with the development or persistence of maternal behaviour. Injection of ovarian hormones in nulliparous females so far has

not produced maternal behaviour. Injection of ammonia extracts from the anterior lobe of the pituitary produces maternal behaviour of varying intensity in both oophorectomised and intact nulliparous females in a high percentage of cases.—H Briggs. Graphical classification of carbonaceous minerals: the place of the constituents of common coal. Reference was made to the method of classification of carbonaceous minerals developed in a previous paper read in March 1931. Making use of a considerable number of published analyses, the method is applied to each of the constituents of coal (vitram, duram, and fusam) in turn. The resulting charts show the relative state of evolution of these components in any seam. Generally speaking, the fusam of any given bituminous coal is more advanced in rank than the other components. With an anthracite, however, the disparity in rank is less, the vitram having caught up with the fusam, and having sometimes, indeed, become the more anthracitic of the two.—A C Aitken. On the orthogonal polynomials in frequencies of type B. Neither of the two types of series which are commonly used to represent probability or statistical frequency, the so-called series of type A and type B, is free from irregularity in the order of magnitude of its terms. In 1928, C V L Charlier conjectured that in the case of type A this defect might be removed by expressing the logarithm of frequency as a series of Hermite polynomials. The correctness of this was confirmed by Dr A Oppenheim and the present author in 1931. An analogous procedure is now shown to be valid for the case of type B.—D M Y Sommerville. Isohedral and isogonal generalisations of the regular polyhedra. An isohedral polyhedron means one whose faces are all congruent or mirror images, and an isogonal polyhedron one whose vertices have equal corresponding plane angles and dihedral angles. A detailed examination is made of all isohedral or isogonal polyhedra, in Euclidean and non-Euclidean geometry, which are isomorphic with the five regular polyhedra. Of special interest are the isohedral icosahedron and the isogonal dodecahedron, neither of which, unless it is regular, has either a circumscribed or an inscribed sphere. It is of interest also to note that, while in Euclidean geometry two rhombic hexahedra exist with the same faces, differently arranged, in non-Euclidean geometry the only hexahedron whose faces are symmetrical quadrilaterals is the regular hexahedron. Further, four different isohedral octahedra can be constructed with the same triangular faces, differently arranged.

## PARIS \*

Academy of Sciences, Dec 28.—Mlle Lucienne George. The relations of the Gnetales with the Dicotyledons and the Gymnosperms.—E. Mège. The taxonomic values of the leaf characters of cereals.—H Colin and M Quillet. The composition of the jelly of *Auricularia mesenterica*. Hydrolysis gave mannose and arabinose. No ketonic sugar was found.—Marcel Chopin. Study of commercial colloidal complexes: application to indiarubber. A detailed account of a method of preparing rubber films for mechanical testing: concordant and repeatable measurements can be obtained with films prepared by the method indicated.—A Damiens and Mlle S Baignan. The normal bromine in plants: food grains, wheat, bread. The seeds of about twenty plants were examined, and bromine was present in all, with the exception of rice and beans, in which the halogens are present in traces only. The ratio of bromine to chlorine was not found to be constant, but varied from  $85 \times 10^{-3}$  (lentils) to  $2.8 \times 10^{-3}$  in wheat.—J André Thomas. Researches on the obscure vesicles of *Sipunculus*. The reproduction by budding. The observations described lead to the

\* Continued from p. 215

conclusion that the vesicles of *Sipunculus* are special stages in the evolution of a new parasite, which give rise by budding to young vesicles—Alphonse Labbé The food factor in the specific coloration of eolidians—Raymond Hovasse Radiolaria and Silicoflagellæ—Mézincesco The rôle of the non-essential amino-acids in the partial supply of the specific endogenous nitrogen consumption—F Marceau and L Acolat General considerations on the circulation of the venous and arterial blood in the three-cavity hearts of vertebrates and the measurement of the degree of their admixture—F Maignon and M A Chahine The nitrogen balances in white rats submitted to egg albumin fat and to egg albumin glucide regimes. Fats exert a favourable effect on nitrogen metabolism and result in a better nutritive yield of the proteins from the point of view of proteosynthesis—A Leulier and F Postic The influence of nitration and of amination on the physical and physiological properties of methylphenylmalonyl urea (rutonal) and of ethylphenylmalonyl urea (gardenal or luminal) The introduction of the nitro or amino group into the benzene nucleus of hypnotics of the phenylmalonyl urea group lowers the partition coefficient between water and olive oil The hypnotic effect is also lowered—Georges Bohn and Mme. A. Drzewina The morphogenic action of betaine on the eggs and larvae of the sea-urchin—Ch Hervieux The search for indoxyl (indican) in the milk of cows and goats Some authors do not admit that indoxyl colouring matters can, in the normal state, pass into the milk The experiments described, carried out on twenty-five specimens of normal milk, gave positive reactions for indican with thymol in every case—Edouard Chatton and Andre Lwoff The conception of an apostome ciliate (Fectinigeridae and Opalinopsidae) Proofs of its validity—E Fernbach The period of preservation of solutions of tuberculin A solution of tuberculin (dilution  $\frac{1}{4}$ ) made up in 1907 was proved to be active in 1913, nearly six years later A further test of the same solution made twenty-five years after dilution showed that it had not lost its activity The solution was kept in sealed sterilised tubes, at 20° C, and in the dark—Jean Régner and Robert David Contribution to the study of microbial multiplication The modifications in the composition of different liquid culture media brought about by the microbial increase (pyocyanic bacillus) It does not appear that the arrest of growth is due to exhaustion of the food supply The chemical changes produced in the media are not proportional to the bacterial growth.

## SYDNEY

Linnean Society of New South Wales, Oct 28—Lilian Fraser The reaction of *Viminaria denudata* to increased water content of the soil The shrub can survive a condition of soil saturation for extended periods and reacts to this condition by the production of both upright and 'knee-bend' pneumatophores, and by the production of a secondary aerenchyma in submerged roots, which is cut off from a phellogen arising in the pericycle, replacing the cork layers of the normal root—F A Craft The physiography of the Shoalhaven River valley (6) Nerriga Consideration is given to the origin and significance of the drift, and a special study of land forms in various strata is made The valley types are dated with reference to late Tertiary basalt, and it is hoped that this will permit the identification of similar forms in places from which basalt is absent—A H S Lucas Notes on Australian marine algae (6) Description of six species of marine algae as new; they belong to the genera *Gelidium*, *Pterocladia*, *Nitophyllum*, *Champia*, *Lessonia*, and *Caulerpa*

## Forthcoming Events

## Societies

## FRIDAY, FEBRUARY 12

- ROYAL ANTHROPOLOGICAL INSTITUTE (Sociological Research Committee) (at 52 Upper Bedford Place), at 4—Mrs Seligman The Method of Exhibiting Genealogical Data—C W M Hart Is it correct to regard all Australian Tribes as on the same Economic Level?  
ROYAL ASTRONOMICAL SOCIETY, at 5—Anniversary Meeting  
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5—Prof H A Harris The Comparative Anatomical Aspect of Pre-Natal, Infantile, and Adult Disease in Man and Animals, with special reference to Bone Growth (2) (Hunterian Lecture)  
ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Sir John Cadman Petroleum A Record of Achievement in Applied Science

## MONDAY, FEBRUARY 15

- ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4—Wilfred Trotter Hunterian Oration  
INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (in Arts Theatre, Liverpool University), at 7 30—Prof J K Catterson-Smith Everyday Uses of Electricity (Faraday Lecture)

## TUESDAY, FEBRUARY 16

- ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15—Sir William Bragg Recent Work on Crystal Analysis (2)  
ROYAL SOCIETY OF MEDICINE, at 5 30—General Meeting of Fellows

## WEDNESDAY, FEBRUARY 17

- BRITISH ACADEMY, at 5—Prof H. J. Fleure Archaeology and Folk-Tradition (Sir John Rhys Memorial Lecture)  
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5—Prof W E Le Gros Clark The Structure and Connexions of the Optic Thalamus (1)  
INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7 30—J M Donaldson Presidential Address  
FOLK-LORE SOCIETY (Annual General Meeting) (at University College), at 8—Presidential Address

## THURSDAY, FEBRUARY 18

- ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15—Prof. J. B S Haldane Heredity in Man (1)

## FRIDAY, FEBRUARY 19

- INSTITUTION OF CHEMICAL ENGINEERS (Annual Corporate Meeting) (at Hotel Victoria, Northumberland Avenue), at 12 noon—W A S Calder Control of Industry (Presidential Address)—At 2 15—Dr Ezer Griffiths Thermal Insulation  
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5—Prof W E Le Gros Clark The Structure and Connexions of the Optic Thalamus (2)  
ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Prof C F Jenkin The Mechanics of Shifting Sands

## Public Lectures

## FRIDAY, FEBRUARY 12

- ST BARTHOLOMEW'S HOSPITAL MEDICAL COLLEGE, at 5 30—Dr L Findlay The Feeding and Nutritional Disease of the Infant (3)  
UNIVERSITY COLLEGE, at 5 30—Prof Sir Reginald Fleming Johnston China in the Ancient World

## SATURDAY, FEBRUARY 13

- HORNIMAN MUSEUM (Forest Hill), at 3 30—Mrs Olwen Brogan Town-Life in the Roman Empire.

## MONDAY, FEBRUARY 15

- GUY'S HOSPITAL (in Physiological Theatre), at 5—Dr. A E Barclay The Use of X-Rays in Physiological Investigations The Mechanism of Swallowing

UNIVERSITY OF LEEDS (in Chemistry Lecture Theatre), at 5 15—Prof P. Kapitza Phenomena in Strong Magnetic Fields

KING'S COLLEGE, LONDON, at 5 30—Prof S H Hooke The Myth and Ritual of the Old Testament and the Culture Patterns of the Ancient East Traces of Early Myth and Ritual in Canaan.

#### TUESDAY, FEBRUARY 16

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5 15—Prof A E Boycott. Hypertrophy and Atrophy (2)

INSTITUTE OF INDUSTRIAL ADMINISTRATION (at Institute of Hygiene), at 6 30—E S Byng. Elimination of Waste in Industry

#### WEDNESDAY, FEBRUARY 17

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4—Dr A R Neligan The Organisation of Treatment for Industrial Rheumatism

KING'S COLLEGE, LONDON, at 5 15—Prof J Holland Rose The Mediterranean in Ancient History (5) The Mediterranean Empire and its Influence on Civilisation  
BELFAST MUSEUM AND ART GALLERY, at 8—Dr. R H Hunter. The Wonders of the Human Body.

#### THURSDAY, FEBRUARY 18

UNIVERSITY OF LEEDS (in Physics Lecture Theatre), at 2 30—Sir William Bragg The Laboratory and the Citizen

UNIVERSITY COLLEGE, at 5 30—Prof E G Gardner Campanella and the City of the Sun—Sir J J Thomson. Physical Lines of Electrical Forces and their Application to the Interpretation of the Electromagnetic Field (1).  
MEDICAL SOCIETY OF LONDON—Dr J. D Rolleston Benjamin Ward Richardson, his Life and Work (Chadwick Lecture)

#### FRIDAY, FEBRUARY 19

UNIVERSITY COLLEGE, at 5 30—Sir E Denison Ross The Unification of Asia under the Mongols

ROYAL VETERINARY COLLEGE, at 5 30—T. M. Doyle: Diseases of Birds due to Filterable Viruses (1).

#### SATURDAY, FEBRUARY 20

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3—Discussion of Members' Topics

HORNIMAN MUSEUM (Forest Hill), at 3 30—H N Milligan. Nature Studies on the Sussex Coast.

### Official Publications Received

#### BRITISH

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1400 (Ae 521—T 3131) Experiments on a Model of R 101, with Applications to determine the Steady Motion By Dr R Jones and A. H. Bell Pp 31+17 plates 1s 9d net No 1417 (Ae 538—T 3118) Scale Effect on High Tip Speed Airscrews By A S Hartshorn and Dr G P Douglas Pp 17+9 plates 1s net No 1425 (Ae 545—T 3149) Models for the Determination of Critical Flutter Speeds By Dr W J Duncan Pp 5 4d net (London H M Stationery Office)

Department of Agriculture Straits Settlements and Federated Malay States General Series, No 6 Technical Reports for the Year 1930 Pp iii+84 50 cents General Series, No 7 Reports of Agricultural Field Officers for the Year 1930 Pp iv+116 Classified List of the Principal Original Articles published in the Agricultural Bulletin of the F M S and S S and the Malayan Agricultural Journal for the Period 1913 to 1930 (Vols 1 to 18) Pp iii+35 (Kuala Lumpur)

Department of Scientific and Industrial Research Report of the Water Pollution Research Board for the Year ended 30th June 1931, with Report of the Director of Water Pollution Research Pp iii+39 (London H M Stationery Office) 9d net

Proceedings of the Society for Psychological Research Part 122, Vol 40, January Pp 105-164 (London) 4s

The Proceedings of the Physical Society Vol 44, Part 1, No 241, January 1 Pp viii+113 (London) 7s net

Department of Scientific and Industrial Research Report of the Building Research Board, with the Report of the Director of Building Research for the Year 1930 Pp viii+136 (London H M Stationery Office) 2s 6d net

The Scientific Proceedings of the Royal Dublin Society Vol 20 (N S), No 15 Cytological Studies of Potato Plants affected with certain Virus Diseases By Dr Phyllis Clinch Pp 143 172+plates 4 8 5s Vol 20 (N S), No 16 The Effect of an Insufficient Supply of Vitamin D on the Growth of the Skeleton and Internal Organs of Chickens By E J Sheehy and Miss K Sheil Pp 173-179+1 plate 1s (Dublin Hodges, Figgis and Co, London Williams and Norgate, Ltd)

Journal of the Royal Microscopical Society Series 3, Vol 51, Part 4, December Pp xvi+347 511 (London) 10s net  
Economy Advisory Council Committee on the Mineral Content of Natural Pastures Seventh Report Pp 17 (London H M Stationery Office) 3d net.

Empire Cotton Growing Corporation Report of the Executive Committee to be submitted to the Meeting of the Administrative Council on January 21st, 1932 Pp 10 (London)

Department of Scientific and Industrial Research Forest Products Research Leaflet No 6 Dry Rot in Buildings—Recognition, Prevention and Cure Pp 5 (London H M Stationery Office)

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 53 The Flying Fox (*Pteropus*) in Australia By F N Ratcliffe Pp 81 Bulletin No 54 Investigations on "Spotted Wilt" of Tomatoes, 2 By J G Bald and Geoffrey Samuel Pp 24 (Melbourne H J Green)

#### FOREIGN

Field Museum of Natural History Geological Series, Vol 6, No 1 The Auditory Region of the Toxodontia By Bryan Patterson (Publication 305) Pp 27 (Chicago) 25 cents

Ministry of Agriculture, Egypt Technical and Scientific Service Bulletin No 107 The Occurrence of the "White Rot" of Onion (*Sclerotium cepivorum*, Berk) in Egypt By Dr R M Natrass Pp ii+9+9 plates 3 P T Bulletin No 117 On the Biology of *Chrysomphalus ficus* Ril (Hem., Cocc) with Suggestions on the Control of this Species in Egypt By Prof Dr H Friesner Pp 20 2 P T (Cairo. Government Press)

Ministry of Public Works, Egypt Physical Department The Nile Basin Vol 1 General Description of the Basin, Meteorology, Topography of the White Nile Basin By Dr H E Hurst and Dr P Phillips (Physical Department Paper No 26) Pp xi+144+157 plates. (Cairo Government Press) 50 P L.

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft 112 Jahresversammlung vom 24 bis 27 September 1931 in La Chaux de Fonds Pp 488 (Aarau H R Sauerlander und Co)

U S Department of the Interior Geological Survey Bulletin 836 A Mineral Industry of Alaska in 1930 and Administrative Report By Philip S Smith (Mineral Resources of Alaska, 1930) Pp ii+115+142 20 cents Bulletin 836 B Notes on the Geography and Geology of Lituya Bay, Alaska By J B Mertie, Jr (Mineral Resources of Alaska, 1930) Pp ii+117 135 5 cents Professional Paper 170 A Glaciation in Alaska By Stephen R Capps (Shorter Contributions to General Geology, 1931) Pp ii+8+2 plates 15 cents Professional Paper 170 C A Miocene Flora from Grand Coulee, Washington By Edward Wilber Berry (Shorter Contributions to General Geology, 1931) Pp ii+31-42+plates 12-13 10 cents Water Supply Paper 705 Surface Water Supply of the United States, 1930 Part 10 The Great Basin Pp v+92 20 cents (Washington, D C Government Printing Office)

Division of Fish and Game of California Fish Bulletin No 32 The California Halibut (*Paralichthys californicus*) and an Analysis of the Boat Catches By G H Clark (Contribution No 109 from the California State Fisheries Laboratory) Pp 52 Fish Bulletin No 33 Fishing Methods for the Bluefin Tuna (*Thunnus thynnus*) and an Analysis of the Catches By S S Whitehead (Contribution No 110 from the California State Fisheries Laboratory) Pp 32 Fish Bulletin No 34 Salmon of the Klamath River, California 1 The Salmon and the Fishery of Klamath River, 2 A Report on the 1930 Catch of King Salmon in Klamath River By John O Snyder Pp 130 (Terminal, Calif California State Fisheries Laboratory)

University of California Publications in American Archaeology and Ethnology Vol 28, No 5 Wintu Myths By Cora Du Bois and Dorothy Demetropoulou Pp 279 403 (Berkeley, Calif University of California Press, London Cambridge University Press) 1 25 dollars  
Proceedings of the California Academy of Sciences, Fourth Series Vol 20, No 6 The Diatoms of Sharktooth Hill, Kern County, California By G Dallas Hanna Pp 161 263+plates 2-18 1 50 dollars Vol 20, No 7 A New Subspecies of Coral Snake from Guatemala By Karl P Schmidt Pp 265 267 15 cents Vol 20, No 8 Birds and Mammals from the Kootenay Valley, Southeastern British Columbia By Joseph Mailhard Pp 269 290 25 cents (San Francisco)

Pratt Institute School of Science and Technology Michael Faraday, 1791-1867 a Selected List of Books and Periodical Literature compiled by the Applied Science Department of Pratt Institute Free Library appropriate to the Centenary of Faraday's discovery of Electromagnetic Induction, September 24, 1831 Pp 13 (Brooklyn, N Y)

U S Department of Agriculture Miscellaneous Publication No 127 Peafowl and their Care By W L McAtee Pp 4 (Washington, D C Government Printing Office) 5 cents

Smithsonian Miscellaneous Collections Vol 85, No 10 Human Hair and Primate Patterning By Gerrit S Miller, Jr (Publication 3130) Pp 13+5 plates (Washington, D C Government Printing Office)

Bergens Museums Årsbok, 1931 Hefte 1, Naturvidenskapelig rekke Pp 43+50+10+47+52 Bergens Museum Årsberetning 1930-1931 Pp 111 (Bergen A S John Griegs Boktrykkeri)

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Comité National français de Géodésie et de Géophysique Section de Magnétisme et Electricité terrestres Troisième mémoire sur le Nouveau Réseau Magnétique de la France au 1er Janvier 1924 Anomalies du champ magnétique terrestre en France Par E Matthias, Ch Maurain, L Eblé et Mlle Homery Pp 8 (Paris Les Presses universitaires de France)

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## The Supply of Biologists\*

THE Committee of the Economic Advisory Council appointed in 1930 to "consider the obstacles which stand in the way of the education and supply of biologists for work in this country and overseas, and to submit recommendations for the removal of such obstacles", has recently issued its Report. This is based on evidence obtained from an exhaustively diverse body of witnesses, and deals with every aspect of the problem, including even a brief appreciation of the value of natural history.

The general public undoubtedly as yet fails to realise that, other than in the medical profession, there exist in Government services, in industry, and in teaching a number of posts which are open only to biological workers. This failure is due to lack of information. There is no machinery for placing before potential candidates, their parents, and schoolmasters any comprehensive statement of the various classes of biological Government posts that are likely to be vacant at any given date, together with information as to salaries and prospects of promotion, nor is there co-ordination among the departments employing biologists in Great Britain.

A similar uncertainty with regard to biological posts in the Colonial Empire—the largest employer of biologists under the Crown—is a grave deterrent to men contemplating biological careers, there being no assurance as to the number of vacancies in any given year, nor uniformity of conditions in the terms of service offered by the several Colonial Governments. It is suggested that if there were introduced for Colonial biological appointments the same degree of certainty as already exists for candidates seeking employment in the Home and Indian Civil Services, parents, schoolmasters, and university tutors would then be in a position confidently to advise young capable biologists to compete for one of the guaranteed posts, and the supply of competent workers in biological fields would greatly increase.

Uncertainty, then, is the first obstacle. The second is the financially unattractive character of the careers offered to biologists in the Colonial Service, and the poor prospect of promotion. This deterrent would be greatly reduced if there were uniformity of conditions of service and scales of pay throughout the Colonial Dependencies, and if high administrative positions were attainable by

\* Economic Advisory Council. Committee on Education and Supply of Biologists. Report. Pp 68 (London: H.M. Stationery Office, 1932.) 1s net.

biologists possessing the necessary administrative capacity

The demolition of these two main obstacles will itself effect the reduction of the remainder "Once it becomes generally recognised that there are careers in biology, the public will turn their attention to the opportunities offered for their boys, and parents will see to it that the schools provide the instruction, once the schools give the proper position to biology in the curriculum, boys will begin to become interested, and the attractions of careers offered by biology will be weighed against those offered by classics" and other subjects. The process must, however, be gradual, over-production of suitable candidates as a consequence of excessive stimulation would result in disappointment, and would discourage further supply *Festina lente*.

Partly as a result of the foregoing obstacles, biology arrived in the curricula of schools long after chemistry and physics had become firmly established. Indeed, though its position has of late years much improved, it has not yet received universal recognition. Biology should, as an indispensable cultural element, be brought to the notice of every boy, and none should leave school without some knowledge of it. The result of this late arrival is that relatively few boys, and especially too few of the most able, have proceeded to the universities with their minds still open to biology, and at the universities they have continued on the lines of their previous studies in chemistry and physics, particularly if they held scholarships awarded for those subjects. It can scarcely be doubted that among these were some who would have found in biology their *métier*, had the subject but been included in the course of their training.

The consolidated positions occupied by chemistry and physics have enhanced the difficulty of finding a place for biology in school curricula. It has inevitably followed that the number of candidates for scholarships at the universities in these older subjects has become very great, competition has thus become severe, the standard of the examinations has risen, the schools have been driven to excessive concentration on chemistry and physics; and biology has often gone to the wall. Moreover, the biology candidate must perforce have a good elementary knowledge of both chemistry and physics, and thus, from sheer lack of time, cannot attain in his own subject to a standard commensurate with that reached in their subjects by those offering chemistry and (or) physics.

It is recommended as a remedy for this over-specialisation (1) that in the scholarship examinations at the older universities the standard in all branches of science should be definitely lower than the present in chemistry and physics, (2) that in the award, proficiency in one modern language (preferably German) should carry due weight, and (3) that the faculties of science at these universities should discourage excessive specialisation in the schools by insisting that some knowledge of biology and some proficiency in a modern language be shown by all candidates offering science for their honours degree. The adoption of these recommendations will necessitate increase in the number of teachers of biology in schools, for, unless these are forthcoming, it is impossible to create the 'pool' from which the biological services are to be maintained. At the present time, after governments, research institutions, museums, the universities, and industry have extracted their toll, there is left, as is shown by the statistical appendix to the Report, only a small remainder to teach in the schools.

The type of teacher needed in the schools is not only the specialist in biology, but also those who have taken biology as a subsidiary subject in their examination for an honours degree in science, and who are therefore competent to teach biology as a cultural subject in the ordinary curriculum. The supply of such teachers would soon be assured if the regulations governing honours science degrees were modified in the manner suggested in the Report and already quoted.

To give effect to the conclusions at which this Committee has arrived, negotiations are required between a large number of authorities, often independent of one another and regarding the problems from different points of view. The Report therefore urges that, to bring these negotiations to a successful issue, the Economic Advisory Council should recommend His Majesty's Government to invite the President of the Board of Education, in consultation with those of his ministerial colleagues who are immediately concerned, to prepare for their consideration concrete plans for the initiation and conduct of the negotiations.

The Committee has succeeded in indicating clearly where the obstacles lie, and in formulating constructive suggestions for measures by which the flow of biologists may be augmented and cleared of existing impediments. It is to be hoped that the Government will not delay to act upon its final recommendation.



## Faraday's Alloy Steels

*Faraday and his Metallurgical Researches with Special Reference to their Bearing on the Development of Alloy Steels* By Sir Robert A. Hadfield, Bt. Pp. xx+329+58 plates (London: Chapman and Hall, Ltd., 1931) 21s net

THE two papers on Faraday's metallurgical researches presented last year by Sir Robert Hadfield to the Royal Society and the British Association respectively but whetted one's appetite for more. In the volume under review the full meal is provided. In essence it is divided into two fairly distinct portions, one of which is concerned with the man himself, the conditions under which he became what he ultimately was, and the people with whom he was brought into contact. To many of the latter, through their influence upon his work and outlook, real, if indirect, credit for Faraday's own achievements is due. Great care and industry have clearly been devoted to this section of the work, with so much success that readers who neither know, nor possibly even care, about Faraday's metallurgical work will come to know a really great man.

The present study is of the greater biographical interest in that Faraday carried out his work on steel during the very early years of his research career, at the very time, in fact, when the book-binder's apprentice was being gradually transformed into one of the greatest of scientific workers. In a letter regarding his steels, written by Faraday in June 1820, he refers to "the two years that we have worked upon this subject", suggesting that this research may have been started so early as the middle of 1818. The rest of the book will be appreciated to the full only by those to whom metallurgical research, especially in the domain of special steels, is of immediate interest. To a wide circle of readers, however, some of the fascination will be felt even here.

We have already referred to the work described in Sir Robert Hadfield's papers on the samples of Faraday's steels discovered in the Royal Institution (NATURE, Jan. 9, 1932). From these, certain alloys which were known to have been made were missing, and since some, which contained large amounts of the very precious metals, were among the most interesting of all, the loss was the more deplorable. By almost incredible good fortune, the major portion of these have since been recovered and subjected to the same thorough examination as were the earlier materials. Two types alone of all the alloy steels which Faraday

made are now lacking from the samples known, namely, that containing osmium and iridium and the one containing tin.

The ten specimens forming the subject of this continuation of the research had been deposited at the Science Museum by their owner, Mr. A. Evelyn Barnard, a nephew of Jane Barnard, Faraday's adopted daughter. These consisted of a razor made from one of Faraday's own platinum steels by his collaborator Stodart, six small 'buttons' of alloys which had been melted in the famous 'blast furnace', and three samples of platinum and steel which had been welded together. In Faraday's diary for Nov. 3, 1823, is the record of the production of nine metallurgical samples, with seven of which the present materials can definitely be identified. It would have appeared out of the question two or three years ago that we should ever have known more about Faraday's steels than he himself told us in his papers, and that we should ever have been able to identify the exact melts made after the last of the metallurgical papers had appeared, and even the day and the order in which the melts were carried out, would have seemed beyond the bounds of possibility.

The total quantity of these new materials which Sir Robert Hadfield has had for investigation was less than six ounces, and the number of tests which could be made was correspondingly restricted. The amount of information which has been gathered is, however, surprising. By comparison with 'buttons' of Swedish iron fashioned into a similar size and shape—obviously a very tedious business—approximate measurements of even the magnetic characteristics have been obtained. The more interesting samples consist of platinum and rhodium alloys, each containing nearly fifty per cent of the special metal, a palladium steel with half the quantity of that metal, and three samples of steel and platinum welded together in attempts to imitate Damascus steel. The properties of the rhodium alloy are probably the most interesting. The sample, which had a mirror polish over most of the upper surface, showed, despite the century since it was made, no sign of rust. It contained only 0.12 per cent of carbon with 48.8 per cent of rhodium. One of the most outstanding physical characteristics of this 'steel' is its high magnetic permeability, which is of the same order as that of the purest commercial iron. Its Brinell hardness of 350, too, is high for an untreated material. When exposed to the Sheffield atmosphere for two days, however, slight rusting occurred at one point, so that the most resistant of Faraday's alloys, as

this was, is yet inferior to the stainless steels produced to-day

The book is unique, in no other hands could more information regarding these steels have been obtained, and it is doubtful whether in any others nearly so much would have resulted. In one direction only can anything be added to what is here contained. To the writer of this review it appears that Faraday's Bakerian Lecture on the colour of thin metallic films is worthy of credit as great as that due to his work on steel. When discussing the effects of heat upon gold leaf, Faraday showed that at a certain temperature the latter lost its metallic lustre and became transparent. In discussing the reasons for this he says ("Experimental Researches", p. 397) "As already mentioned, it might be thought that the gold leaf had run up into separate particles. If it were so, the change of colour by division is not the less remarkable, and the case would fall into those brought together under the head of gold fluids." It would not have been a long step from this observation to the conclusion, reached much later by Beilby, that polished metallic surfaces are covered with a vitreous layer of the metal and to the well-known 'amorphous hypothesis'. F. C. T.

### Epidemiology of Insect Pests

*Die Forstinsekten Mitteleuropas ein Lehr- und Handbuch* Von Prof. Dr. K. Escherich. Band 3, Spezieller Teil, Abteilung 2 *Lepidopteroidea*. Die "Schnabelhafte" (*Panorpatæ*), die "Kocherfliegen" (*Trichoptera*), die "Schmetterlinge" I (*Lepidoptera* I), *Allgemeines, Kleinschmetterlinge, Spinner und Eulen*. Pp. xi + 825 + 14 Tafeln. (Berlin: Paul Parey, 1931.) 57 gold marks.

IT is unfortunate that the title of this remarkable volume is misleading and may prevent the ideas put forward in it from becoming the property of general biology, to which they naturally belong.

Applied entomology is usually regarded as a purely descriptive and empirical science. Indeed, many biologists would not hesitate to consider it as not a science at all, but rather a craft. However, the last decade or two have witnessed profound changes in the methods of economic entomology, which is evolving rapidly into a real science, with its profound analysis of the causation of phenomena and the application of exact quantitative methods drawn from a wide range of other sciences. Economic entomologists of the present day study their insects against a background of the environment, and the study is not restricted to the external

phenomena of bionomics, but special stress is laid on the physiological characteristics of the insect, its limits of toleration with regard to various environmental factors, and the influence of these factors on its development and propagation. An insect is conceived as a physiological system, developing and acting in a world of physico-chemical influences, which can and must be analysed and correlated with definite phenomena of insect life. Observations in the field and subjective deductions from them are giving way to experimental studies in a laboratory and to exact investigations of the environment.

The principal aim of these studies is the discovery of the causes underlying the well-known but still largely mysterious phenomenon of the fluctuations in the numbers of an insect, which make it a pest one year, while in the next it does not attract any attention. Modern economic entomology is, therefore, assuming the character of an epidemiology of insect pests, and quantitative studies of insect population as affected by fluctuations in environmental factors from year to year attract the chief attention of entomologists. This point of view and these methods of work have proved most fruitful, and there is every promise that economic entomology will soon rise to the rank of a science the results of which will be of direct interest and of great value to very wide circles. Indeed, injurious insects, appearing as they do in enormous numbers, present an exceptionally favourable material for analytical investigations of the factors regulating the numbers of individuals of a species. Thus, insect epidemiology opens a way to a scientific analysis of one of the most central points of the evolutionary process.

The book under review hides under its unpretentious title a masterly presentation of this new aspect of economic entomology. The methods and results of epidemiological research are discussed in its general part, while the special part contains a wealth of facts, all arranged according to the epidemiological conception of entomology. The chapter on the pine moth (*Panolis flammea*, L.) can be recommended for reading to every biologist interested in general evolutionary problems, because this pest has been recently studied epidemiologically by a number of outstanding entomologists, and the results, summarised by the author in a very concise way, represent a unique picture of the life of a species as a whole and in the actual, enormously complex environment.

It is interesting to note that the results of epidemiological work on various insects tend to stress

the importance in the life of a species of the physical environment. Organic factors of control, such as predators, parasites, and diseases, in most of the cases sufficiently studied, play a definitely subordinate part, and the population of a pest is usually regulated by climatic factors, coupled with the surprisingly inadequate adaptation of insects to the vagaries of climate. It is only in some cases that the controlling influence of organic factors becomes significant, and this happens usually towards the end of an outbreak of the pest. The initial abnormal increase in numbers leading to an outbreak is always due, not to the reduced activities of natural enemies, but to the fluctuations in the course of weather, which constitutes an ever-present and continually active regulating factor. It is only fair to add, however, that the author himself is more conservative on this point than the majority of his followers in epidemiological studies.

A few minor faults may be mentioned, merely in order to stress the general excellence of the book. The problem of the selection of food plants by insects is discussed (p. 43) much too briefly for a problem of such outstanding practical and theoretical interest. The treatment of the literature has a definite bias towards German works. This is perhaps excusable so far as the special part, treating forest insects of central Europe, is concerned, but in the general chapters more attention could be directed to the valuable work of American physiologists and ecologists. For example, readers who may want to know more about the technique of physiological studies are referred to certain German books (Friedrichs, etc.), but Shelford's unique compendium is not mentioned. On p. 38, the investigations on the tarsal perception of taste by butterflies are credited to Frisch instead of Minnich, and on p. 84, an incorrect statement is made that aeroplane dusting against locusts has been developed in South Africa, while the actual paper by Mally, quoted in this connexion, refers only to experiments on dust poisons, no work with aeroplanes against locusts has ever been undertaken in South Africa, to the best knowledge of the reviewer.

A feature of the book are the numerous illustrations, including both text figures and coloured plates. Originals for most of the plates have been drawn by Herr von Kennel, a well-known authority on Microlepidoptera, and their exactitude and artistic quality of reproduction are in keeping with the generally high standard of the book.

Forest entomologists will find a mine of information on their subject in the book, workers in any

other branch of economic entomology should certainly read it, in order to obtain a definite conception of their science, the general biologist who can be persuaded to read it would have no grounds to regret the time spent on it. Economic entomologists should feel now that their science is beginning to find its place amongst other branches of biology, and this is largely due to the life-work of Prof. Escherich and his numerous pupils.

B. P. UVAROV

### The Geochemistry of Igneous Rocks

*The Chemical Analysis of Rocks*. By Dr. Henry S. Washington. Fourth edition, rewritten and enlarged. Pp. xvi + 296. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 20s net.

DR. H. S. WASHINGTON is well known throughout the geological world as the most prolific of rock-analysts, as the author of a long series of petrographical papers, as the compiler of the records of analyses known familiarly as "Washington's Tables", and, to chemists as well as geologists, as the author of this invaluable guide to the chemical analysis of igneous rocks. The present edition has been thoroughly revised and enlarged in order to incorporate descriptions of new methods and the uses of new reagents which have, in the author's experience, proved to be simple and reliable. Details of procedure are so fully and clearly given that the book can be used with complete confidence by any capable student. Apart from the descriptions of apparatus, operations, and methods, the general discussion of the value of rock analyses and of the occurrence of the rarer elements is of great interest. It is rightly pointed out that "an analysis complete as to the subsidiary constituents may be of great value in the future or to others, even if this degree of completeness is not necessary for the end immediately in view."

A plea for completeness is worthy of particular attention at the present time, when the importance of the geochemistry of igneous rocks is just beginning to be properly appreciated. It is commonly thought, for example, that all peridotites are derivatives from basaltic magmas, notwithstanding the fact that some, like the mica-peridotites, are quite clearly independent of basaltic associations and have a very different assemblage of the rarer elements from those of basaltic origin. This is particularly noteworthy in the case of  $P_2O_5$ , F, BaO, and SrO, and consequently it may well be that detailed analysis will provide in doubtful

cases a criterion for discriminating between peridotites that come directly from the substratum and those that are merely accumulations of the early crystals of basaltic magma.

The work of Fersman shows that the nepheline-syenites and their relatives have associations of elements which differ considerably from those of both the granitic and basaltic families. This feature seems fatal to the general application of the Daly hypothesis of limestone assimilation, and consequently more detailed analyses are indispensable if the origin of the alkali rocks is to be intelligently discussed. It is disappointing to find in the majority of petrological papers analyses that are copious in number but deficient in detail. Petrologists should insist on all the detail they can get, for even the rarity or absence of a minor constituent is likely to be evidence of positive value. The high standard in this respect reached by the analysts of the Geological Survey of Great Britain, and particularly by Dr. H. F. Harwood, of the Imperial College of Science and Technology, is already directing attention to problems of fundamental importance that cannot as yet be adequately discussed on a world-wide scale for lack of the necessary data.

Dr. Washington's book is of particular value because of his insistence on a high ideal of accuracy and completeness. If time be a consideration, it is well that the petrologist and his chemical colleague should realise that a few detailed analyses are worth very much more than a large number that stop after twelve or fourteen constituents have been determined.

ARTHUR HOLMES

### Language through the Looking Glass

*Through Basque to Minoan Transliterations and Translations of the Minoan Tablets*. By F. G. Gordon. Pp. v + 83. (London: Oxford University Press, 1931.) 10s. 6d. net.

IN this book the experiment is tried of assigning modern Basque values to the Minoan characters on bronze age tablets from Crete. As Mr. Gordon says (p. 1), "such a method must obviously begin as pure guess-work." It also ends there, for "not only did the system yield a language indistinguishable (at present) from Basque, but it revealed unmistakable references to Hellenic deities, several old Greek names, and three poems, one in hexameter verse, one in elegiac, and one in couplets" etc. Basque is lovely for the purpose "the language is highly fluid, the aspirate is uncertain, and inversions are common" (p. 2), and

"it appears to make no distinction between B, F and M, T and N, G and K, L and R, O and U." It was also "an obvious convenience" that "the authors of the script were able to select signs with several meanings" (p. 3), and Mr. Gordon's "method", as he frankly says (p. 4), "consists in applying a series of hypothetical values, and endeavouring to show that they fit everywhere." For example (p. 9), with a sign which "appears to represent a conical eminence of some kind, and is provisionally rendered *iaq* or *iq*, Basque *ik* 'height'", he thinks it "possible to write the plural the agential suffix, the partitive suffix, the past participle, and the imperative singular, besides using the sign as a connecting link." English itself has never attempted as much, and it is not surprising that "it would constantly occur, therefore, as in fact it does." Another sign (for "beard, *bizal*, Basque *bizar*") "may also stand for a univalve of contorted type" (for which no Basque word is given), because it "stands as a decoration in a marine subject", being in fact what the Germans call a "Fullenornament" of the commonest, in Late Minoan pot-painting.

The proof of the pudding is, however, in the eating. A well-known tablet (Hull, "Ægean Archaeology", pl. xxxiii) not only "tells a connected story" (p. 4), but tells it "quite in the spirit of the Greek Anthology." Scholars familiar with the Anthology must judge for themselves a composition which is "only what might have been expected from the Minoan genius." Here is this "epigram", an "elegiac Muopotmos", and "the work of a practised hand", of which "the rhythm goes with a swing" (p. 16). *A spider in its web, holding thread in its mouth, a flesh-fly, round-headed, flower-skinned, the little wine-jar tapper. Take care, drinker, embracing a tomb with the mouth, drinking wine—alas! alas! He has spun round, dead!* As Mr. Gordon says (p. 14), it is "a little disconcerting at first", but it is sober prose compared with the translation of the Phaistos Disc which he offers on pp. 55-67. This latter document, he thinks, is a metrical calendar, partly elegiac. Here is one of the pentameters *Yasah dad bidraq yadzua ullueduq izal*, and it means (through Basque to Minoan) "the lord, smiter of the horse-hide (or the surface of the rock), the dog climbing the path, the dog emptying with the foot the water-pitchers."

Indeed, only one question remains unanswered. Does the imprint "Oxford University Press" on the title page mean what it says or (into Basque through Minoan) something different? JOHN L. MYRES

## Short Reviews

*Studies in the Literature of Natural Science* By Julian M. Drachman Pp xi+487+6 plates (New York The Macmillan Co., 1931) 17s net

As science becomes more and more popular, the man of science can no longer isolate himself in the laboratory, he must communicate his attainments to the general public in books which can be read without spending a lifetime in the mere learning of an alphabet. If it could be shown that the writers of scientific classics produced what in some cases were works of literary art, that might be a more convincing argument still. Such is the task which the author of this interesting book sets himself to do. He confines his research to the literature of natural science in the nineteenth century, which is dominated by men of genius like Darwin, Lyell, Owen, Huxley, and Tyndall, pointing out in each case how art and science are happily interconnected. The general conclusion of this historical investigation is that the writer of books on scientific subjects can vastly increase the number of his readers and the efficiency of his presentation by means of increased attention to the literary art.

Besides a number of interesting quotations from the sources, and the novel commentary presented by the author of several classical scientific works, there are two points in this book which should be mentioned. One is the new 'cyclical' classification of the sciences, which are divided into four groups—mental, human, natural, physical—each of which is further divided into sub-groups. The arrangement illustrates in a striking manner the mutual interdependence of the sciences. The other point is a questionnaire on the literature of science which was answered by various scientific workers and writers, and is intended to show that there is no essential contradiction between literature and science. Huxley's "Essays" have had more votes than any other as a "particularly fine book of popular science." T G

*A Manual of the Dragonflies of China a Monographic Study of the Chinese Odonata* By Prof. James G. Needham (Zoologia Sinica, Series A. Invertebrates of China, Vol. 11, Fascicle 1) Pp ii + 344 + 11 + 20 plates (Peiping The Fan Memorial Institute of Biology, 1930) 5 dollars, 20s

THIS bulky memoir is based upon researches that were supported by a grant from the Heckscher Foundation of Cornell University, and it forms a notable contribution to a knowledge of the little explored insect fauna of China. The material which rendered the work possible was obtained from many sources and includes that collected by Dr. Needham during a year's residence in China. Altogether 266 species of dragonflies are described, of which 58 are regarded as being new to science. They are included in 89 genera, of which the single genus *Simolestes* is new. The memoir is very fully illustrated by 20 plates which portray structural

details of both adults and of the few nymphs that have yet been discovered. We congratulate the author, and those responsible for its publication, upon the production of a work that will be welcomed by students of the Odonata throughout the world.

*Thought Transference (or What?) in Birds* By Edmund Selous Pp xi+255 (London Constable and Co., Ltd., 1931) 7s 6d net

MR. SELOUS holds a high place as an observer of bird behaviour, and in the present small volume he gives much admirable description in support of his view that the concerted actions of flocks can be explained only by postulating some kind of 'thought transference' between the members. The apparently simultaneous rising of a flock of rooks without obvious extraneous stimulus, the unanimity with which a party of dunlins wheel in their dashing flight, the sudden hush that stills the screaming of a colony of terns—these and many other examples of community behaviour the author observes over and over again with minute care.

The crux lies, of course, in the interpretation, and the reader may doubt whether the human eye is not deceived by an appearance of simultaneity that is in fact an extreme rapidity of imitative action. The author, indeed, seems to give part of his case away when he describes instances in which the movement could be seen spreading through the flock. Even so, there are difficulties, for why are some movements of individuals instantly conformed with by all the rest, while other movements—as the author points out—are ignored by the majority? The phenomenon is, at the least, a remarkable one, but Mr. Selous admits that his explanation would itself require to be explained. The author's method of presenting his matter in the raw, that is, wholly in the form of extracts from his diary embellished with footnotes, will probably appeal to some readers, but it will repel those who prefer a more orderly marshalling of evidence and argument.

*The British Journal Photographic Almanac and Photographer's Daily Companion with which is incorporated 'The Year Book of Photography and Amateurs' Guide' and 'The Photographic Annual', 1932* Edited by George E. Brown Pp 684 + 64 plates (London Henry Greenwood and Co., Ltd., 1932) Paper, 2s net, cloth, 3s net

THIS well-known handbook for photographers needs no introduction to readers of NATURE: it has been published annually for more than sixty years. This year there are five articles by well-known writers on photography. The latest advances in photography and photographic apparatus are discussed in a space of one hundred and sixteen pages. A further eighty-four pages gives a great mass of formulæ and other technical information. Not least in importance are the advertisements, which are very numerous and sufficiently descriptive to be of great use in a handbook of photography. The examples of pictorial photography cover a wide range of subjects and are well produced in photogravure. S O R

## Photo-Elasticity

LONG ago it was remarked by Brewster that a transparent elastic solid such as glass ceases to be optically isotropic when it is bent or otherwise strained by external forces. It then shows chromatic effects in the polariscope, which vanish if the state of strain be relieved. That was the beginning of photo-elasticity, a science which, many years later, has become developed into a powerful means of investigating complex conditions of stress for the information of the engineer. It can readily be applied in cases which are too complicated for mathematical analysis, and even in less complex conditions photo-elastic experiments are often highly useful, providing short-cuts to the required results, or confirming the analysis of the mathematician. Whether the distribution of stress is simple or otherwise, the photo-elastic method makes the mode of distribution strikingly apparent. The polariscope is an incomparable showman, as entertaining as it is instructive. It appeals alike to the mathematical and the non-mathematical mind. The distribution of stress exhibited by the transparent solid applies to an engineering material such as steel, provided the elastic limit is not passed.

Lately, I saw in Prof. Coker's laboratory a transparent model of a locomotive driving-wheel revolving in contact with a loaded roller which pressed on the rim as the rail presses on the real wheel, the whole working in circularly polarised light and throwing its image on a screen. The chromatic effects, as each part of the rim and each spoke in turn took up its duty and then passed it on, made a brilliant spectacle—as fascinating a 'movie' as any engineer could wish to see, all the more as the spectator could control the speed or introduce a pause at any stage.

In modern developments of the subject the favourite medium for the study of stress is not glass but some form of celluloid. Xylonite, which engineers know as a material of which set-squares are often made, answers well. It is inexpensive, and is easily procured in transparent plates which are sufficiently uniform in thickness and quality, are free from internal stress, and come near enough to the ideal of perfect elasticity. It is not brittle, and is easily cut into strips or rings or flat pieces of any form, so that it may serve as a replica in miniature of the engineering article the behaviour of which under stress is to be studied—such, for example, as a plate weakened by rivet-holes. Readers of NATURE who are unacquainted with the subject may like to be told briefly what is the process by which the polariscope is made to reveal the condition of stress in such a specimen.

Imagine, then, an optical bench with a source of light such as a pointlight lamp at one end and a projection screen at the other. The bench carries a pair of crossed Nicol prisms, between which the specimen is placed—a flat strip or plate of xylonite a quarter of an inch thick, or less, with its plane at right angles to the rays—so that light polarised by the first Nicol passes through the specimen in the

direction of the thickness. The piece is held in what is virtually a small testing-machine, in order that measured loads—pulls or pushes or both—may be readily applied in its own plane. Each of the Nicols is furnished with a removable quarter-wave plate of mica, allowing either circularly polarised or plane polarised light to be used at pleasure, and the Nicols may be rotated together in order that their crossed axes may be set at any angle to fixed axes in the specimen. The specimen is cut from a uniformly thick plate, so that the polarised light traverses the same thickness at all points of the material under examination.

So long as no load is applied, the material is isotropic, and has consequently no action on the polarised light. In that condition no light passes through, for the second Nicol stops what has come through the first. But let stress be applied, the xylonite then develops a birefringent quality, causing a relative retardation of part of the polarised ray, with the result that colour effects appear on the screen. To take the simplest case, let the piece be a strip under uniform tensile stress in the direction of its length, then the image will have a definite uniform colour depending on the amount of that stress, and as the stress is increased the colour will change through a sequence of tints that correspond to Newton's colour scale for thin plates. Let uniform push be applied instead of pull, and gradually increased, the same sequence of colours is again seen, the colour for push being the same as for an equal intensity of pull. Or, to take another example, let the piece be stressed as a beam under uniform bending moment in its own plane, the image will then show a set of longitudinal colour bands. The neutral axis will appear as a black central band, since there is no stress there, and on either side of it—above and below—there will be a series of parallel colour bands grading into one another, which show how the intensity of longitudinal push or pull increases with the distance from the neutral axis towards one or the other edge.

In each of these examples there is only one principal stress  $P$  at any point, and the colour there directly exhibits the value of  $P$ . But in general, for less simple states of elastic strain in a loaded plate, there will be two principal stresses  $P$  and  $Q$ , at right angles to each other, and it is easy to show that what the colour really tells is the difference  $P - Q$ . At any point where  $Q$  happens to be equal to  $P$  no light gets through the polariscope. There the image has a dark spot; at all other places there is colour. As the magnitude of  $P - Q$  increases from point to point of the plate the tint changes, following the Newton colour sequence, and the image on the screen accordingly exhibits strong colouring in the form of isochromatic curves, each such curve being a locus of points at which the value of  $P - Q$  is constant. Incidentally, therefore, these isochromatic curves exhibit directly the amount of shearing stress at each point, for the shearing stress is everywhere proportional to  $P - Q$ .



The main object of the test, however, is to determine the principal stresses separately, and for that a further experimental analysis is required. We now change from circularly polarised light (which was best for exhibiting the isochromatic curves) to plane polarised light, by removing the quarter-wave plates, and set the crossed nicols at a particular azimuth or direction in the plane of the plate. The image now shows certain dark bands corresponding to places at which the two directions of principal stress are parallel to the axes of the two nicols. A locus of such points is called an isoclinic curve, for at these points the principal stresses have constant inclinations with respect to any arbitrarily chosen co-ordinate axes. Points on the isoclinic are recorded by marking the screen with little parallel crosses, the limbs of which lie in the directions of the principal stresses, these directions being given by the setting of the crossed nicols. Next, the setting is changed by turning the nicols through, say,  $15^\circ$ , and another isoclinic is then observed and is recorded in the same way. Proceeding thus, with progressive turning of the nicols through  $15^\circ$  at a time, we obtain a complete system of isoclinics for the whole plate, from which it is easy, by aid of the marked crosses, to sketch in the double system of lines of principal stress.

These lines give everywhere the directions of  $P$  and  $Q$ , but the magnitudes of  $P$  and  $Q$  have still to be determined. The colour bands, as we have seen, depend on  $P - Q$ , and the value of that quantity may be inferred by matching the colour at any point of the strained specimen with the colour shown by a strip of the same material and thickness strained by a known simple pull. But accurate colour matching is not easy, and a very much better way, due to Coker, is to superpose the auxiliary strained strip so that the polarised light passes in series through it as well as through the main specimen. The auxiliary strip is set so that the direction of pull in it is at right angles to the principal stress  $P$  at the place under examination. Then by adjusting the stress  $P'$  in it until a black spot appears in the image, we know that  $P = Q + P'$ , and hence  $P'$  gives a direct measure of  $P - Q$ .

To find the value of  $P - Q$  is not enough when we want separate values of  $P$  and of  $Q$ , so, following Mesnager, Coker carries out a supplementary observation. By means of a delicate lateral extensometer, which measures the elastic change of thickness of the plate at any point, he infers  $P + Q$  from the observed amount of lateral contraction. Then, combining this information with the results of the optical tests, the whole problem is solved,  $P$  and  $Q$  are each determined, in magnitude and direction at every point. The process is laborious, but the final results are complete and convincing in many cases they can be usefully checked by integrating graphically over a section on which the whole stress is known from the conditions of loading. Often the process may be simplified by starting from a free edge, where one of the principal stresses is necessarily zero.

All this, and much more, is fully discussed by Profs Coker and Filon in their recently issued

treatise,\* along with an account of how the method has been applied to a host of important practical examples. This fine volume, with its 720 large pages of print, its numerous colour plates, and its many hundreds of admirably drawn illustrations, is a monument not only to the ability and industry of the joint authors, but also to the enterprise and technical skill of the producers, the Cambridge University Press. The typographic form is worthy of the matter, and to say that is high praise. The authors here treat with affectionate completeness a subject they have made peculiarly their own. They have spent many years in perfecting it and demonstrating its uses. Much of their original work has been done in close association. Now they present us with the fruits of a happy collaboration in authorship, where the critical insight of the mathematician and the practical flair of the engineer combine to provide a comprehensive, systematic, and extremely lucid treatise. Readers who know both authors may find material in the book for an interesting guessing game, as to which parts, so to speak, are Sullivan's and which are Gilbert's. But the main point is that the whole is a good blend. The authors make an exceedingly strong team, they pull well together and each supplements the many virtues of the other.

After a short introduction, we have several chapters of general theory. The relevant optics are discussed on the basis of Maxwell's electromagnetic waves, and this is followed by a chapter on the theory of elasticity, before the theory of artificial double refraction is attacked, on which the whole process depends. The first half or so of the work will be of general interest to physicists, apart from the solution of special problems of engineering with which the later sections abound. These comprise many detailed applications of the method, to tension and compression test-pieces and pieces under shear, to beams and bridges, to thick cylinders, to plates with holes and notches and cracks, to eye-bolts and fastenings, to rings, chains, hooks, wheels, to the action of cutting tools, and to other examples too numerous for mention here. Some of them are very recent—they include studies undertaken by Coker for a special committee of the Department of Scientific and Industrial Research, which has not yet reported, in critical examination of certain customary types of test. All of them illustrate the wide sweep of the method, its power to illuminate obscure matters, and its great value as a guide in design. To have produced such a work is a professional service for which engineers—contemporary and future—cannot fail to be deeply grateful.

Such a treatise was, in fact, greatly needed. It is a new departure: no book has hitherto been available that covers anything like the same ground. Students of the subject have had to refer to scattered papers or lectures, many of them by Coker and Filon themselves. The book will be welcomed as filling a definite gap in the literature.

\* *A Treatise on Photo-Elasticity*. By Prof. E. G. Coker and Prof. L. N. G. Filon. Pp. xviii + 720 + 14 plates. (Cambridge: At the University Press, 1931.) 50s. net.

of scientific engineering. Engineers know that the methods of photo-elasticity—methods of experiment with which they are still for the most part unfamiliar—have already become important auxiliaries in design. Such a treatise will, I believe, be no less attractive to the physicist, to whom it will appeal in the rare moments which find him willing to turn aside from the atom and the photon to revise, and perhaps enlarge, his ideas of what happens to the 'classical' Maxwellian waves when they traverse solid aggregates. If he discovers how to harmonise the two modes of thought, so much the better.

There is, paradoxically enough, one defect. The book is so big, so full, so thorough, that it must fail of one important purpose: it is not a textbook for the ordinary student of engineering. He needs something much more brief, direct, and simple—something that will show him the optical bench and tell him plainly how to use it. So many elementary accounts have already appeared in lectures and addresses to learned societies that the authors must be tired of that kind of exposition, but it still needs to be embodied in a handbook that will be a really handy book. Such a task is well worth doing. This excellent voluminous

treatise will always be there for more advanced study and as an encyclopædia of reference the small book, which has yet to be written, would introduce readers to it and would spread knowledge, in a way the treatise cannot be expected to do, of a subject which should be taught in every engineering laboratory, and should become, at least in its elements, part of the mental equipment of every educated engineer.

To me the book brings a personal pleasure, for it happens that both Coker and Filon were at one time my pupils. It was in the engineering laboratory at Cambridge, more than thirty years ago, that Filon carried out his earliest photo-elastic research on a loaded beam of glass. For that, however, I can claim no credit, not even the credit of suggestion. His experiments were initiated and pursued in a fine spirit of independence, a virtue only too rare among research students. Nor had I any hand in the subsequent efforts, successful and long sustained, to which this book bears witness. But even so, it gives an old teacher some satisfaction to see original work of high quality proceed from those whose early notions he may have had some small share in shaping, and to sit, as I now do, a learner at their feet.

J. A. EWING

### Albertus Magnus

#### HIS SCIENTIFIC VIEWS

"EVERYTHING there was to be known, he knew." Thus is the genius of Albert the Great characterised by the Pope in the remarkable Bull "In Thesaurus Sapientiæ" declaring the blessed Bishop of Regensburg a saint and a doctor of the Church. In this "Decretal Letter", dated Dec. 16, 1931, but published on Jan. 14, 1932, Pope Pius XI points out that Albert the Great (1206–1280) was not only a lover of God, a pastor of souls, and a master of the sacred sciences, but also a pioneer in secular knowledge. He wrote about astronomy, physics, mechanics, chemistry, mineralogy, anthropology, zoology, botany, architecture, and the applied arts, and the modern edition of his writings makes thirty-eight thick quarto volumes (ed. Jammy O. P. repr. Vivès, Paris, 1890 sq.). Indeed, Albert the Great broke the chains that kept natural science in the hands of unbelievers, and vindicated it against the more timid pious persons of his time who were afraid of it for fear of its abuse. For, says the Pope, "no real theologian is afraid of any damage from the operations of nature or of natural reason rightly investigated, for these very things bear upon them the light of the Creator himself."

We do not propose here to give any account of the edifying and active life of St. Albert the Great, or to report on the various causes which led to his canonisation by the Church. Nor do we intend to give an outline of the theological and philosophical views of a master mind who is now honoured as one of the twenty-eight doctors of the Church, together with Gregory, Basil, Ambrose, Augustine,

Jerome, Thomas Aquinas, Anselm, Bernard, Bede, Ephraem, John of the Cross, and Bellarmine. We shall endeavour, however, to give a short sketch of the scientific views of Albert the Great, which are of the greatest interest for the history of science, especially as they represent the state of scientific knowledge in the Middle Ages.

Though Albert seems to be less original and forceful as a scientific thinker than his contemporary Roger Bacon, yet he was far more influential on the age in which he lived. The peculiarity of his encyclopædic teaching was that it was based entirely on the writings of Aristotle. This was remarkable because the Aristotelian principles were resisted by the Church at the time, the provincial council at Siena in 1210 going so far as to forbid the use of Aristotle's books on natural philosophy. But though no professor was permitted to lecture on them, and in spite of the fact that in 1215 the "Physics" and the "Metaphysics" were banned by the statutes of the University of Paris, Albert the Great was actively promoting the new philosophy, probably with the connivance of the Church authorities, who allowed a responsible theologian to sift the true from the false while they acted as the stern guardians of orthodoxy. He soon joined hands with his pupil Thomas Aquinas, who, if he surpassed his master in the theological and philosophical interpretations of the Stagyrte's system, does not, however, compare favourably with Albert in his scientific studies.

The astronomical beliefs of Albert, though partly

inspired by Aristotle, differ widely on many important points from the views of the Stagyrte. Albert taught that the heavens move from east to west carrying along with them their particular stars which move from west to east, "something like the motion of an ant on a wheel rotating in a contrary direction." The whole world is like a huge machine moved by God according to secret principles which the human intellect, however, can partly discover. Each star, in turn, is moved by a pure intellect, each having its own heavens with its particular motion, so that the circles of the stars are not concentric, as Aristotle on the authority of Eudoxus taught, but eccentric as in Ptolemy's system. Yet the earth is at the centre of the world, the heavens of the Moon, Venus, Mercury, the Sun, Mars, Jupiter, Saturn, the fixed stars, the aqueous, the crystalline and the empyreal heavens, coming in succession, the last-named being the dwelling-place of the blessed. It is this system which must have inspired Dante's cosmology, and we find in the "Paradiso" (x 98-99) this reference to Albert the Great:

Questi, che m' è a destra più vicino  
Frate e maestro fummi, ed esso Alberto  
È di Cologna

Albert was not entirely satisfied with his cosmological theories, which are sometimes very difficult to follow (see Duhem, "Le Système du Monde", t 3, p 327 sq). He knew that his opinion could not be final when he wrote that "celestial phenomena are so far away from anything we know that we have no means of understanding them perfectly. All we know for certain is that the heavenly bodies are moved by a soul, that is, by a separate substance, an intellectual mover, a unit of intellectual life" ("De Coelo et Mundo", 2, 13).

The belief in the existence of a pure intellect in each heavenly body led Albert to share the current opinion of his time about the influence of the stars on human beings, each intellect having a direct influence over the one immediately following it in the hierarchy of spirits. At the top of the scale, the omniscient and omnipotent mind of God controls the whole of the world, right down to the elements, the compound and the simple bodies. Parallel with this hierarchy of creatures there is a hierarchy of light and a hierarchy of weight: the four traditional elements, earth, water, air, and fire, are thus drawn up in echelons from the heaviest, earth, which is at the bottom or in the middle of things, to water, then air, and finally fire which rejoins the celestial bodies—a conception which reminds one of Anaximander's cosmogony. These considerations on the order in the realm of matter have their equivalent in the realm of spirit: the simplest intellect gives the most perfect motion to the star to which it is attached, and again, the simplest and most perfect intellect has the most adequate knowledge of things, the intrinsic and epistemological power of the various creatures being thus echeloned from the Highest God to the humblest of His creatures. The detailed development of this powerful vision of the

nature of reality allows Albert the Great to state and explain his views about the various provinces of our knowledge: the part played by each natural or spiritual being is thus accounted for according to its place in the hierarchy of God's creatures.

Details about the particular sciences are interesting. In alchemy, for example, Albert himself tried several reactions, describing accurately enough the preparation of nitric acid or, as he called it, 'prime water' or philosophical water to the first degree of perfection, and giving at the same time its principal properties, such as the oxidation of metals and the separation of gold from silver. By combining three parts of prime water with one part of sal ammoniac he obtained the secondary water, the tertiary water is obtained by treating mercury with the secondary water, and the fourth water is the result of the distillation of the tertiary water after it has been left for four days in a vessel covered with manure. This fourth water was very popular among the alchemists of the time, who called it 'philosophers' vinegar', 'mineral water', and 'celestial dew'.

Albert distinguished four 'metallic spirits', mercury, sulphur, orpiment, and sal ammoniac, which could all be used to stain metals in gold or silver. But he warned us that the gold or the silver of the alchemists is not pure gold or silver. In fact, though the theory of a 'materia prima' and the conception of transmutation made chiefly an intellectual and philosophical appeal to him, Albert did not believe in the actuality of transmutation. Thus he wrote in "De Mineralibus" (Bk 3, 9): "Alchemy cannot change metals, but can only imitate them. I have tested alchemistic gold, but after six or seven heatings, it is burned and reduced to ashes." He was the first to use the word "affinitas", in his treatise "De Rebus Metallicis", which was no doubt suggested to him by the views of ancient Greek philosophers current at the time, that chemical reaction is due to a similarity or kinship between the reacting substances, or, as maintained by Hippocrates, that like unites only with like. Thus, said Albert, "sulphur blackens silver and generally burns all metals, because of its natural affinity with them" (propter affinitatem naturæ metalla adurit). It seems also that Albert was the first to call sulphate of iron "vitreolum". His small treatise "De Alchymia" gives a vivid picture of the state of alchemy and alchemists in the Middle Ages, a picture which has been confirmed since by the descriptions of Paracelsus.

In his biological works Albert follows very closely Aristotle's text, given a sentence or two of the Stagyrte and adding his own remarks by way of commentary, in sifting what is Aristotle's from Albert's additions, it has been found that the remarks of the Dominican monk contain a considerable amount of personal observations which prove that he was a naturalist of great ability. In his "Short History of Biology" (pp 73-74), Prof Charles Singer quotes a long passage of Albert's treatise "De Animalibus" in which there are

some striking remarks about embryos of birds and of fishes, while he considers Albert's book "*De Plantis*" as the best work on natural history produced during the Middle Ages. Albert seems to be at a loss, however, in his attempt to draw up any general account of plants, since he reaches no satisfactory basis of classification, and is equally ignorant both of their minute structure and their true mode of reproduction. Yet his descriptions are fairly accurate, and show that he had a remarkable gift of observation.

These general remarks illustrate the range of Albert's knowledge and scientific interests. He probably wrote also on mathematics, as he often refers to his mathematical works, especially the 15th and 16th books of his geometry (in *Met* 2, 1), but these works have not reached us. We know, however, that Albert placed mathematics between metaphysics and natural science, the object of mathematics being defined as the motion and material extension of natural objects independently of their essence and their fundamental causes. The mathematician studies the straight line, for example, as it is materially illustrated in Nature, but he does not consider the cause of the straight line or the particular matter which illus-

trates it. Such considerations were possible, of course, at a time when Euclidean geometry was the only known system in terms of which Nature could be interpreted.

To-day these and the other scientific views of Albert the Great could scarcely bear the strain of a searching criticism. It would be unfair, however, to dismiss Albert's claims to consideration because they do not correspond to the extraordinary developments of modern science. Should one ignore Aristotle or Plato because his biology or his cosmology is behind the present state of science? Every system of philosophy has to give some account of Nature, with reference to the scientific beliefs of the time. None of the great thinkers of the past could have possibly established his doctrines in terms of the science of the future, nevertheless, one studies them as they are and often uses them in the interpretation of modern scientific conceptions. The scientific doctrines of Albert the Great are entitled to a similar consideration, and the historian who devotes his patient efforts to the study of the "*doctor universalis*" will be repaid to the full by the discovery of the valuable indications contained in his writings.

THOMAS GREENWOOD

### The Iron and Steel Industry

MR BOFFIN, it may be remembered, introduced Mr Weg to Mrs Boffin as "the gentleman that's a going to decline and fall off the Rooshan Empire." Prof W A Bone may be introduced as the gentleman who has taken the opportunity, as Melchett metallist of the Institute of Fuel, to decline and fall off our coal and iron industry. Behind the subject he discussed, "*A Century of Fuel Economy*"—in (1) the manufacture of iron and steel, (2) of gas and coke and (3) in the production of power—lies the gradual decay of our iron industry. If European nations agree to disarm, if we continue to develop the use of the road engine, the interest in iron must pass over to nations like Japan and China—to the unsettled East. The topic is, therefore, one of extreme public importance.

Born in a region of coal and raised in the reek of coke-oven, gas-producer and blast-furnace, a lifelong student of the processes, Prof Bone is a man of fuel by instinct, able to envisage and discuss the problems, both of coal and of iron, with detachment and a fullness of ripened knowledge which no other worker, either industrial or academic, has at his command. He is the recognised master artificer in the field of high temperature change, especially in gases. By his recent systematic studies of coal he has revolutionised our conception of its nature. The special department he has developed at South Kensington stands alone and unrivalled in the completeness of its equipment and the accuracy of its apposite inquiries. The Institute of Fuel could not have paid a greater compliment to the man whose memory the medal commemorates, nor have

done a greater service to industrial interests, than it has in making him its metallist and so forcing him to display his knowledge of the subject, which is probably, at the moment, the most important to be considered in the whole range of industrial activity.

The story opens with the downfall, as politician, of the Duke of Wellington, in 1832, and the coincident introduction, by the Scot, J B Neilson, of the hot blast, the first great step in the modern development of the iron industry, signalling the dawn of fuel economy. Neilson appears to have been a most remarkable man and a pioneer in technical education. He had intuitively guessed that the expenditure of a given quantity of fuel (small coal) outside the furnace for the purpose of preheating the ingoing blast would save many times more fuel (coke) inside the furnace. Paradoxical though it seemed at first, trial soon proved him to be right.

The output of Scottish pig-iron rose from 37,500 tons in 1830 to 196,960 in 1839 and to 475,000 tons in 1845. Next came the utilisation of the furnace gases but not until after 1845, when the great Bunsen and his pupil Lyon Playfair reported to the British Association the result of their analyses of the gases, taken at various levels, from a coal-fired blast furnace, pointing out that 81.54 per cent of the fuel was lost in the form of combustible matter, only 18.46 of the whole fuel being realised in carrying out the processes in the furnace. The second invasion of the chemist into the industry was Lowthian Bell's great inquiry (1868-72) into the complex chemical interactions within the blast

furnace Lowthian Bell stands alone as the colossus of the industry—he has yet to be monumentised.

Steel was also advancing. Coincidentally, strange to say, with Perkin's discovery of the first coal tar colour, came Henry Bessemer's invention (1856) of his process, in which iron, taken directly from the blast furnace, was converted into steel by merely blowing air through the molten metal. A great further advance was made, in 1880, when Thomas and Gilchrist substituted a basic for the acid lining of the Bessemer furnace. This, however, threw open the production of iron to the world, as it made possible the use of low grade phosphatic ores, which were previously unworkable. It also greatly aided agriculture, by the introduction of basic slag. It is noteworthy that this advance was practically coincident with that caused by the introduction of azo dyestuffs, which threw the colour industry open to the world. Great Britain's hold upon the colour industry and upon the pig-iron industry waned at about the same time, by no mere coincidence but for similar reasons. Just as we had no second set of workers to compare with the Perkin-Nicholson-Hofmann triumvirate, so we had no second iron and steel triumvirate to compare with the Lowthian Bell-Bessemer-Snelus cum Thomas and Gilchrist combine. Those in commercial charge of both industries were too short sighted to secure the necessary succession of scientific workers: the trained chemist has scarcely been known in the blast furnace industry. Only steel has attracted academic attention. We have recovered our hold upon colour but the blast furnace industry is still lacking in vision and has not put its house in order up to the present day; labour difficulties have been an additional drawback. Prof Bone holds out science as still a key of promise to some further economy in the use of fuel. Users of coal may rejoice at his conclusion but it is one that brings cold comfort to owners and producers. It is imperative, however, that false hopes should not be held out in public in this connexion.

The century of invention Prof Bone discusses is only about fifty years in advance of the beginning of the steel age. Children are taught something of the flint, the iron and the bronze ages, archaeologists gloat over rusty bits of iron found in old Roman foundations yet we look complacently, without wonder, at modern steel defiance of the Tower of Babel legend, this too when our ores are on the verge of exhaustion. Of the many great names mentioned in the course of the address, excepting that of Lord Playfair, scarce one of them is to be found in current literature or the histories—yet they are the men who have made our world what it is. The ministers who figure, for example, in Queen Victoria's "Letters" have been largely automata, owing their importance almost entirely to the backing they have had in coal and steel. Politicians may trumpet their messages from Geneva and Washington but, as Shanghai shows, steel bombs are the messengers which eventually tell in forcing order. The East is too ignorant and too human ever to be reformed by mere talk: the work will need to be helped on by steel in some form.

It is because the story of steel is so ill-told in our schools, so little understood by politicians, that the public to-day has no suspicion of the way in which the world is under ferrous control. If the Highgate Hexaphilites were to name us, we should not be called Calciferites—though we have much lime in our bodies—but Ferrosoferites. Iron is the great social adjuvant, not merely in our blood. Having gone so far in laying bare the statistics of the industry, Prof Bone might with great advantage now prepare the way for a future Mr Weg to decline and fall off the Empire of Coal and Steel, to which the nations, during a century past, have far too exclusively directed their attention. Everything points to a more superficial cultivation of the soil than that involved in mining for iron. Maybe the farmer will yet have his revenge and see iron put in its place, if not in Queer Street—if we no longer build warships, big guns and tanks, if the railways cease to pay because we have taken to the roads and run upon slag rather than upon steel.

The present unhappy state of the British blast furnace industry is deplorable. It was inevitable that we should lose the supremacy we once had and that countries with full command of ore and coal supplies—Belgium, France, Germany, the United States—would both satisfy their own demands and seek to be exporters. It is very doubtful if it will pay us, as long as competition is unrestricted, to supply our own needs, let alone export at a profit. Whether, under a system of regulated fair trade, we shall do so is another question. The art is not one to be lost, as we have no guarantee that the accident of war may not come upon us, moreover, much phosphate is to be gained from our low grade ores. Germany, beyond question, has greatly overbuilt her ironworks—definitely with the object of capturing outside markets. To stop armaments and yet carry on a merciless commercial war in iron will be to create a purely Gilbertian situation.

The rapid development of the American iron and steel industry has been a necessary consequence of the vastness of the continent, the great demand being over, it is unreasonable for the industry to expect that it can be run at full blast at the expense of other countries. The sky-scraper in New York is a logical outcome of the conditions prevailing there—of the limited area at disposal and the existence of Silurian foundations. New York, however, is no excuse for towns in the Far West out on the open prairie. The sky-scraper is simply an American habit. Is it to become one here? We are learning every day more and more to value light—why, then, should we shut it out? We know our English heating system to be more healthy than the Continental and American plan. Everyone who lives in them is beginning to complain of the beehived, graceless constructions now coming into being at the instance of speculative builders. Might we not pause to think if iron after all be worth what it is going to cost us, indirectly perhaps more than directly, in convenience, comfort and health. It has probably too long been our master.

HENRY E. ARMSTRONG

## Obituary

MR GEORGE FORREST

**B**OTANISTS and horticulturists have received with the greatest regret the news of the death of Mr George Forrest from heart-failure, at Tengyueh, in West China, on Jan 5. He was one of the greatest of botanical collectors, and had the good fortune to find the richest of fields for his explorations.

Forrest was born at Falkirk on March 13, 1873, and was educated at Kilmarnock Academy. As a young man he spent some years in Australia and South Africa. Returning to Scotland, he was engaged for a time on herbarium work at the Royal Botanic Garden, Edinburgh. In 1904 came his opportunity. On behalf of Mr A. K. Bulley, of Neston, he made the first of his journeys to western Yunnan to collect plants and seeds. From that time onwards he devoted himself, with but brief vacations, to exploration in Yunnan and the adjoining regions.

The floral richness of the provinces of western China and of eastern Tibet was long unsuspected. A foreshadowing of the botanical wealth of the area came first from the dried collections of Prof. A. Henry and from the material sent to Paris by the French missionaries such as David, Delavay, and Soulié. These noteworthy collectors did not, however, explore in any detail the higher alps of the Tibeto-Chinese frontier, nor did they forward much to Europe in the way of seeds. Consequently, the area was almost virgin country for the horticultural explorer. It was now that Wilson and Forrest, and later Kingdon Ward, Schneider, Handel-Mazzetti, and Rock, entered such a promising field. Wilson had Hupeh and Szechwan for his domain, and "*Plantæ Wilsonianæ*" is testimony to their botanical riches. Forrest was but a year or so later, and chose western Yunnan and the adjoining parts of Tibet and south-west Szechwan. For multiplicity of species this is the richest area in China, and has good claims to possess the finest alpine flora in the world. Forrest made no fewer than eight expeditions into these regions. The number of his dried botanical specimens exceeded 30,000. Many of the species had been found before by the French missionaries and described by Franchet at Paris, but many hundreds were new, and these specially natives of the higher altitudes between 10,000 ft and 15,000 ft.

Forrest kept an even balance between the claims of botany and horticulture. He made it his endeavour to secure seed of all plants of horticultural merit and also of any botanical interest. His dried material forms one of the great collections, worthy of comparison with that of any previous explorer in any country. Apart from copious field notes, the material is of the very highest standard, witness the statement of a Japanese botanist, Prof. Kudo, who has just published, after fifteen years' study, a monograph on the Labiatae of eastern Asia. For that purpose he visited some forty of the chief herbaria in Europe, Asia, and America, and records

of his examination of Forrest's specimens that his collection of Chinese plants is "*die beste in der Welt*" (*Mem. Fac. Sc. Tôhoku Imp. Univ.*, vol. 1, No. 2).

Much of Forrest's success in this respect was due to his capacity for management of the hillmen whom he employed in his travels. These tribesmen were taught by him and became expert in the drying of herbarium material, in the collection of seeds in autumn (implying recognition of what was previously collected in flower—no easy task), and in the skinning of birds and mammals. The hillmen were particularly loyal to him, sometimes travelling six weeks to meet him when they heard he was arriving at Bhamo *en route* for the Chinese Alps. This influence extended to the tribesmen generally, as well as to all classes of Chinese in the towns and villages at lower elevations. Among other kindnesses, he was welcomed for his attempt to do what he could for them in the way of rough-and-ready 'doctoring'. He felt their needs so much that he was in the habit of procuring lymph from Burma, and in his time inoculated many thousands against smallpox. It was only on his first expedition, when feelings between Tibetan and Chinese were exacerbated, that Forrest had serious conflict. That first expedition ended in tragedy. A large party, some eighty in all, including Forrest and two French missionaries (Père Dubernard and another), were assailed by the Tibetans, and only a bare dozen escaped massacre. Père Dubernard was brutally tortured before death, and his companion was killed on the spot. Forrest was hotly pursued for some ten days, without shelter and without food. Of his personal following of seventeen, there was only one survivor.

Though somewhat short of stature, Forrest was of very robust build and was able to endure the roughest of travelling. Unfortunately, he never gave to the world a written record of his experiences in central Asia. Few explorers could have had a more fascinating story to tell, but the task of writing it was always postponed until his days of retirement—and that time did not come. In any event, the task did not appeal to him, and it was only rarely that he could be persuaded to write for publication. His interests lay wholly in the field; his collections of the flora and fauna of the area, supplemented by accurate and very complete notes, have formed the basis of a very large number of scientific papers, while European gardens have been much enriched by the numerous plants raised from the seed secured on his various journeys.

WE regret to announce the following deaths.

Prof. W. Billington, professor of surgery in the University of Birmingham, aged fifty-six years.

Sir Arthur Duckham, president-elect of the Federation of British Industries and one of the founders of the Institution of Chemical Engineers, on Feb. 14, aged fifty-one years.



## News and Views

## Tariff Commission and a Scientific Policy

THE creation of a Tariff Commission, or, as it is called, Import Duties Advisory Committee, as part of the Government's general tariff plan has implications which go far beyond the theoretical merits of 'free trade' or 'protection', and are of special interest to scientific workers. As Capt Harold Macmillan, M.P., points out in recent articles (cf *Week-End Review*, Jan 30, and *Sunday Times*, Feb 14), Britain suffers particularly from the chaotic market conditions which affect all countries, because not only is a large proportion of its production for export, but also because alone among nations it has a home market open to unrestricted competition. In the absence of any protective device, British economic development is being determined not by our own decisions but by the fluctuating disorder of world trade. The old fiscal controversy having now been resolved in principle by the Government decision to apply tariffs to a wide range of manufactures, the question of practice and of the purpose for which tariffs are to be applied becomes of primary importance. It is clear that both ministers and other members of Parliament are now prepared to consider the economic and financial aspects of a tariff policy in relation to the reorganisation, modernisation, and readjustment of industry as part of a definite plan of national and imperial policy. The execution of any such constructive policy, involving the application of scientific methods in this difficult and contentious field, requires a wealth of detailed information regarding the relations between different industries, their productive capacity, efficiency, their importance in the general national economy, the merits of their plans of reconstruction, and so forth.

## Scientific and Industrial Development

THIS information and the essential co-operation of industry can probably only be secured by the creation of representative councils for each of the great national industries, and in this way the Tariff Commission will be brought face to face with rationalisation problems, technical questions of scientific development, industrial organisation, and management. In addition to the technical advice of industrial representatives, the co-operation of the banks, co-ordinated, for example, through some such body as the Bankers' Industrial Development Trust, will be required, since intelligent use of the powers of the Committee involves the complete supervision of every question relating to industrial and commercial development. If the Government proposals are indeed directed towards the evolution of such a deliberately planned national economy, there will undoubtedly occur opportunities of making representations to the Commission upon the scientific position of many of our great industries the development of which is dependent upon technical control and scientific research. It is desirable that the Commission should be aware of what scientific opinion is on such great

industries as the textile industry, the iron and steel industry, etc., and it is incumbent upon representatives of science to follow these developments with the closest attention and to seize the earliest opportunity of making representations or affording other assistance towards the evolution of a creative and scientific national policy.

## Tariffs and Imported Scientific Books

THE text of the Import Duties Bill, whereby an *ad valorem* duty of 10 per cent is to be charged on goods imported into Great Britain, has been issued, and we are glad to see that newspapers, periodicals, and printed books, and radium compounds and ores are among the articles exempted from the impost. As was pointed out in our issue of Feb 6, p 195, the revenue to be expected from a tax on imported scientific literature is negligible, the only effect of such a duty would be to increase the cost of scientific research. It is encouraging to find that this aspect of the matter is appreciated in Government circles, and that, amid the many claims for exemption which have, no doubt, been put forward, consideration has been given to the needs of scientific workers. Affairs do not seem to be so well ordered in Australia. It will be recalled (*NATURE*, Nov 28, 1931, p 900) that the Commonwealth has in force a duty of 10 per cent on imported books and a sales tax of 6 per cent, this, with the depreciation in Australian money, has proved a serious handicap. Incidentally, it has demonstrated our contention that, as a source of revenue, an import tax on books is not worth consideration. However, it is stated by the Canberra correspondent of the *Times*, in a message dated Feb. 11, that a deputation including Sir George Julius, chairman of the Council for Scientific and Industrial Research, has waited on the Prime Minister, Mr Lyons, who has promised to consider the exemption of historical records and scientific periodicals, although he will not consider the early and total remission of the sales tax.

## Discovery and Uses of X-Rays

SEVERAL letters have appeared recently in the *Times* on Prof W C Röntgen's discovery of X-rays and their early use in surgery. As *NATURE* is mentioned by three of the correspondents, it may be worth while to recall the association of this journal with the notices of the discovery. General announcements appeared in the daily Press on Jan 7, 1896, to the effect that Röntgen, who was then professor of physics in the University of Würzburg, had discovered that a number of substances which are opaque to visible rays of light are transparent to waves capable of affecting a photographic plate. A note upon these reports appeared in *NATURE* of Jan 16, 1896 (vol 53, p 253). In the issue of the following week, Jan 23, we published a letter from Sir Arthur Schuster on the physical significance of Röntgen's observations, and Sir Arthur himself arranged for the translation into English of Röntgen's

paper "On a New Kind of Rays" from the *Satzungsberichte der Würzburger Gesellschaft*, 1895, which appeared in the same issue. This, we believe, was the first complete account of Röntgen's work published in England. To the same issue (Jan 23, p. 276) the late Mr A. A. Campbell Swinton contributed an article describing how, "Working upon the lines indicated in the telegrams from Vienna, recently published in the daily papers, I have, with the assistance of Mr J. C. M. Stanton, repeated many of Prof. Röntgen's experiments with entire success", and his article was illustrated by an X-ray photograph of a human hand taken by him with a Crookes tube. In the following three months as many as one hundred and fifty-five notes and original communications upon X-rays and their applications appeared in our columns.

#### Gold Medal for Astronomy

THE award of the gold medal of the Royal Astronomical Society to Dr R. G. Aitken, director of the Lick Observatory, Mount Hamilton, California, was the subject of the presidential address given by Dr Knox-Shaw, Radcliffe Observer, Oxford, at the annual general meeting of the Society on Feb 12. The actual presentation of the medal is deferred until May 13, when the medallist is coming to London to deliver the George Darwin lecture, the subject of this has not yet been announced, but it will probably be connected with double stars. Dr Knox-Shaw began his address by giving a description of the state of double-star astronomy in the middle of the last century, it was taken for granted that the work of the two Herschels and the two Struves had exhausted the mine of possible discoveries, at least in the northern hemisphere, and that it only remained to continue the observation of the known pairs, with a view of obtaining better orbits.

#### Dr Aitken and other Double-Star Observers

WITH the advent of the great American telescopes a new era began. It became possible to detect much closer pairs than before, these offered such a large field that for the first time a distance limit was fixed, beyond which stars should not rank as doubles. This was taken as 5" for stars of the ninth magnitude, but was made wider for brighter stars and for stars of large common proper motion. S. W. Burnham was the first to make a great advance in this direction, in 1906 he brought out a great catalogue of 13,665 pairs, more than two thousand of these being his own discoveries. Dr Aitken has been a worthy successor. With the aid of Dr Hussey, who was his fellow-worker for many years, about four thousand new pairs have been found, and a new general catalogue is in course of formation. An important point is that many of the new pairs are extremely close (separation less than half a second). As was to be expected, many of these close pairs showed fairly rapid motion, in fact, one of them has completed a revolution since discovery, Dr Aitken enjoys the distinction of having made all the observations upon it, and also of computing its orbit. From a physical point of view, the chief importance of double-star astronomy is

the information that it leads to on the masses of the stars. At the beginning of this century not more than a dozen star-masses were known with any accuracy, the number has now been greatly increased, the study of eclipsing binaries having added to it. As a result, Sir Arthur Eddington was able to deduce the law correlating mass with absolute magnitude. This important law rests largely on such work as that carried on by Dr Aitken.

#### Gold Medal of the Hunterian Society

THE Hunterian Society, the oldest medical society in London, offers annually or periodically for competition a medal bearing the profile of John Hunter. It is open to all general medical practitioners resident in Great Britain, Ireland, and the Channel Islands, and is awarded for an essay. The subject of the essay is chosen by the writers from any subject in the medical sciences, and each essay has to be written under a motto or device and is accompanied by a sealed envelope containing the writer's name. In 1931 the Council recommended that the medal should be of gold instead of silver as heretofore, and that a new design should be struck. Accordingly, Mr Thornton Shiells, with Mr H. Youngman, engraver, produced a gold medal the size of a crown piece. The original designs and the plaster medallion made for the purpose are now preserved in the Library of the Society. For the first competition under the new régime a number of essays of high order were received, and the medal has been awarded to Dr Griffith Ifor Evans, 37 Castle Square, Caernarvon, for an essay on "Chronic Familial Syphilis". Dr Gwladys Victoria Smallpiece, of 365 Woodstock Road, Oxford, was declared "proxime accessit". The medal was presented to Dr Griffith Evans at the annual dinner on Feb 11. The next award of the gold medal will be made in 1933 for essays received on or before Dec 31, 1932. The rules governing the award may be obtained on application to the honorary secretary of the Society, Mr Andrew McAllister, 79 Wimpole Street, London, W. 1.

#### Extension of University College, London

UNIVERSITY College, London, has acquired by purchase a site of two acres, formerly occupied by Messrs Shoolbred, immediately south of the buildings of the Faculty of Medical Sciences of the College. This is the largest addition to the site of the College made since its foundation more than one hundred years ago. The site acquired by the founders was some eight acres in extent, and most of the previous additions to the College have been confined to this area. So long as fifty years ago attempts were made by the College to buy the site, on which, eventually, were erected warehouses, depositories, and stables for Messrs Shoolbred. The site was too large for University College to buy or to occupy as a whole. The problem was solved by the Carnegie United Kingdom Trustees, who acquired part of the property as permanent headquarters for the National Central Library and the Library Association. In the College part of the territory there will be housed the Departments of

Zoology and Comparative Anatomy, Botany, Geology, Geography, and Political Economy, and certain other needs will be served there. The Departments moving out of the old buildings of the College will set free accommodation much needed by the Faculty of Arts and by the Libraries. The College has also received a great benefaction for the endowment of the Department of Zoology and Comparative Anatomy from the Rockefeller Foundation. The benefaction amounts to £88,000, and must be devoted to the advancement of research. This gift follows other benefactions by the Rockefeller Foundation, which have made possible the building of the new Department of Anatomy and Embryology and the provision of endowments for that Department and the Departments of Physiology and Pharmacology.

#### British Industries Fair

THE eighteenth British Industries Fair, which will open in London and Birmingham on Feb. 22, will be the largest and most representative display of British manufactured goods that has yet been organised. Last year exceeded all previous efforts, and this year marks a further advance. Following the practice of last year, the Fair will consist of two sections, the London Section and the Birmingham Section. In London the exhibits of the lighter trades and the specifically Empire exhibits will be held at Olympia, the White City will accommodate the display of textiles and clothing, which for the first time will represent all branches of the textile industry. At Castle Bromwich, Birmingham, there will be exhibits mainly of hardware, house equipment, and engineering, and, out-of-doors, an exhibition of agricultural implements and of plant for light railways, quarrying, and roadmaking. The total frontage of the stands in all sections of the Fair will amount to approximately 16 miles. The total number of exhibitors will be 2305, of which 1150 will exhibit their products at Olympia, 130 at the White City, and 1025 at Castle Bromwich. Of the new trade groups that have co-operated in this organised effort to exhibit the variety and extent of British manufactures, mention may be made of the oil section, and of the section for mining, quarrying, and roadmaking plant. The former will provide working exhibits of the latest oil-fired plant, and the latter will give a demonstration of the actual construction of a road. We hope to give, in a subsequent issue, a review of some of the chief features of the Fair.

#### Second Dynasty Burial Rites at Ur

MR. LEONARD WOOLLEY's first report on the current season's work at Ur, which appeared in the *Times* for Feb. 12, chronicles *inter alia* the discovery of a burial of a type "quite out of the ordinary." It has the additional interest that it belongs to the Second Dynasty of Ur, about 2800 B.C., a period and dynasty about which at present nothing is known. The Joint Expedition of the British Museum and the Museum of the University of Pennsylvania is now engaged in endeavouring to trace the earlier history of the sacred area on which stands the famous ziggurat of the Third Dynasty. In the first month's work the complete ground plan of a range of buildings on the

north-west side has been brought to light. The buildings belong to the First Dynasty. The burial to which reference has been made was not discovered here, but in the course of excavating a patch of ground between the predynastic cemetery and the mausoleum of Bur Sin. Eighteen people were found buried at the foot of a rectangular shaft originally at least 20 ft. deep, but of which the bottom is now 30 ft. below the surface. All the bodies, which were bedecked with gold ornaments and beads, had been buried independently, although the burials were contemporary, and the same elaborate ritual had served them all. Above the graves a clay floor had been spread, and on this were fireplaces and a brick-walled enclosure containing traces of food. Above this were two floors, at different levels, with altars, and the shaft was closed finally with rubble and brick packing. Evidently, Mr. Woolley notes, the burial had been by stages, each marked by ceremonies of fire and sacrifice.

#### Co-operation in Archæological Research in France

THE Smithsonian Institution announces the completion of an agreement with the University of Toulouse, whereby the two bodies will co-operate for a period of ten years in the excavation of the cave of Marsoulas in the Haute-Garonne among the foothills of the Pyrenees. The cave is the property of the University, and is already well known to archæologists for its polychrome paintings and wall engravings of palæolithic age. It was first investigated by archæologists in 1886-87, but after that it was comparatively neglected until recent excavation by Mr. J. Townsend Russell of the Division of Old World Archæology of the Smithsonian Institution. The cavern is about thirty metres in extent, but galleries now closed by clay infiltration suggest that at the time of its occupation by palæolithic man it may have afforded more extensive accommodation than at present. It is hoped that it may be possible to open up these galleries. By the time the agreement expires, the cave should be cleared completely. In the meantime the terms of the agreement may be extended to cover other investigations, possibly so far afield as the French Near East and Africa.

#### Recent Excavation in the Marsoulas Cave

EXCAVATION in the Marsoulas Cave during the past season by Mr. Russell on behalf of the Smithsonian Institution has already produced results of importance, which promise well for the future of the joint undertaking. Two ancient hearths were found, of which the upper yielded artefacts typical of the Magdalenian period. Just below was an Aurignacian hearth with typical knives, scrapers, points and decorative pendants of flint and bone. An unexpected find was a triton shell, which must have come from warm water then far to the south, probably from Africa. The technique of one of the numerous wall-paintings observed is described as unique. The animal form had been produced by the thumb of the painter, which had been dipped in the wet pigment and then pressed on the wall. The paintings of the Marsoulas Cave are singular in the fact that they are near the entrance

instead of in the far recesses of the Cave as is more usual. Their excellent state of preservation suggests that the entrance of the cave must have been blocked by an obstruction for a very long period after the close of the palaeolithic age.

#### Cereals for Spring Sowing

THE selection of the best varieties of cereals for spring sowing is always a question of importance for the farmer. To meet this need, the National Institute of Agricultural Botany, Cambridge, has issued a leaflet (*Farmer's Leaflet*, No. 2) describing the varieties most suitable for use in the Midlands, east, and south of England, the recommendations being based on tests carried out at a number of trial stations. The sowing of spring wheat is not, in general, advocated, but of the varieties available, Little Joss is suggested for February and Red Marvel or Al for early March sowings. The choice of oats is, however, much wider. Victory is one of the best all-round varieties, useful both for sale and feeding. Star, an oat similar, on the whole, to Victory, has the additional advantage of a thinner husk and a better standing straw, and is, therefore, preferable on highly fertile soils. Golden Rain and Golden Rain II also deserve consideration when the crop is intended for feeding on the farm, since the colour of the grain is apt to affect the market price adversely. Marvellous is a further variety which usually gives heavy crops, but it is only suitable for early February sowings. As regards barley, the choice lies between the well-established Plumage and Spratt-Archers and the new variety recently produced by Dr Beaven, called Golden Archer. The latter is of the Spratt-Archer type, with similar malting quality, but the yield is rather better. For unusually late sowings, the early ripening Victory is suggested as the most suitable. Early sowing of all spring cereals is regarded as of the utmost importance, irrespective of the variety chosen. In view of the bad harvest conditions of 1931, farmers are advised to pay special attention to germination. The Official Seed Testing Station, Cambridge, undertakes germination tests at the nominal fee of 6d per sample.

#### Selection of Sugar Beet Seed

THE question of the selection of sugar beet seed will soon be receiving the attention of farmers, now that most factories have fixed sugar beet prices for 1932. The results of the exhaustive trials carried out by the National Institute of Agricultural Botany, Cambridge, in recent years, have been reviewed in the light of the new prices, and it can be confidently said that on most soils the heavy yielding (or E types) will pay the farmer better than the high-sugar-content (or Z) types. For general cultivation, Kleinwanzleben E or N, Dippe E, Dobrovice, Hoerning R R, and Zapotil I can all be recommended, Marsters and Johnston's Perfection should be chosen for early sowing, and on very rich land either of these two or Kuhn P. A leaflet describing these strains can be obtained, free of charge, from county organisers, or the Institute, to which application can also be made by those desirous of advice or further information.

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#### Forestry in Kenya

THE Annual Report of the Kenya Forest Department for the year ending Dec. 31, 1930, affords pleasurable reading for all those interested in the progress of forestry conservation and development in the Empire. The whole Colony enjoyed good rains, and a record acreage of new plantations, 4429 acres, was made. Excellent growth both of the new and old plantations was recorded, and there were no forest fires of any consequence. The economic slump, as is a common experience in forestry operations, resulted in a considerable drop in the revenue from timber and from the sale of young trees and seeds. For the first time the revenue from firewood actually exceeded that from timber. This factor alone would justify the far-seeing policy of the Colony's administrators in supporting a correct forest administration. It is of interest to note that the management of the intensively worked forests of the Nairobi District was placed on a satisfactory basis during the year by the completion of detailed working plans. The Chinese tung oil tree, *Aleurites Fordii*, has been previously alluded to in NATURE, and it was mentioned at the time that experiments were being carried out to ascertain the possibilities of growing the tree commercially in several of the Colonies. Great interest is being shown in this tree by farmers in Kenya, and the Forest Department has acted as agent in the distribution of the seed. A few experimental trees have been planted, since it was first grown in the Department's arboretum in 1922, at practically every forest station, to test the suitability of the various districts, but the trees are as yet too young to give definite indications.

#### A Modern Telephone Cable

IN January 1931 a telephone service was inaugurated over a new submarine cable spanning the hundred miles between Key West, United States, and Havana, Cuba. The new cable is the longest deep-sea telephone cable in the world, and it is unique in having neither intermediate repeaters nor inductive loading. A paper describing its engineering characteristics was read by H. A. Affel, W. S. Gorton, and R. W. Chesnut at the winter convention, held in January, of the American Institute of Electrical Engineers. The new cable can operate at a frequency of 28,000 cycles a second, which is about eight times faster than ordinary cables. The feature of the new cable which has made this great improvement possible is the use of paragutta, the new insulating material invented at the Bell Telephone Laboratories. There are three telephone channels in the cable, obtained by an adaptation of the ordinary carrier apparatus used for long distance transmission over open wire lines. There are six frequency bands, one for each direction in the three channels. The largest skin effect occurs in the central conductors, but the effect is also noticeable in the thin return copper tapes. Elaborate precautions were taken to prevent 'noise' intruding in the speech circuit. Frequency limiting filters were introduced into several neighbouring circuits and proved effective. If traffic requirements grow so that more facilities are required, a higher frequency range can be employed.

and additional channels obtained. In addition, if telegraph circuits are required, carrier telegraph systems may be operated in place of one or more of the telephone channels. For example, with the six telephone channels, a possible arrangement would be to employ two of these channels for carrier telegraph circuits. The cable could then carry simultaneously a load of four telephone messages and twenty-four or more two-way telegraph messages.

#### Medical Uses of Radium

THE Medical Research Council has issued a report which summarises the results of research work in the treatment of cancer done during 1930 by means of radium salt entrusted by H.M. Government to the Council (*Special Rep. Series*, No 160 London: H.M. Stationery Office 1s net). It also contains data concerning patients treated in earlier years, and thus maintains continuity with the eight previous and similar reports that have been issued. The stock of radium entrusted to the Council has been distributed on loan to selected research centres throughout Great Britain. Growths of the breast, cervix uteri, and buccal cavity are at present most favourable for radium therapy, but in rectal growths little success has attended the treatment. It is remarked that up to the present no method has been discovered by which malignant cells can be made more radium-sensitive, and that any advance in this direction would have wide-felt effects. Of cases of sarcoma, 23-50 per cent react favourably to radium treatment, and five cases of brain tumour have been treated, with two apparent successes.

#### Physiology and the 'Aura'

IN our issue of Feb. 6, p. 197, a note was published referring to Prof. D. F. Fraser-Harris's paper at a recent meeting of the British Psychological Society, in which he described the so-called human aura as the familiar negative after-image produced by temporal retinal induction. Dr. F. W. Edridge-Green has written pointing out that the phenomenon can be shown with white cardboard, and that it and "numerous others of a similar character are due to the movement of the photochemical fluid in the interretinal space. There appears to be a continuous flow towards the centre of the retina when the eyes are being used." We may add that Prof. E. N. da C. Andrade gave a humorous description of some experiments on this subject in *NATURE* of Dec. 23, 1922, p. 843. Prof. Andrade used his hand and also cardboard hands and figures, and his conclusion was that the effects were due to after-images, an explanation given of a similar experiment referred to by Dr. Edridge-Green in *NATURE* of Dec. 9, 1922, p. 772.

#### Palæontological Expedition to Northern India

It is reported by Science Service that an expedition organised by Yale University under Prof. Hellmut de Terra is proceeding to Northern India with the object of investigating the geology and palæontology of the Salt Range, one of the smaller mountain ranges of Northern India, situated about eighty miles south of the Himalayas. This range, which is con-

sidered by some to be one of the key positions of Asia in the geological sense, is an area of great promise for these branches of research, as it has never been examined systematically for palæontological evidence. The expedition, it is hoped, may find there evidence bearing on the development of man. The members of the expedition, beside the leader, are Mrs. Hellmut de Terra, Prof. G. E. Hutchinson, and Mr. George E. Lewis.

#### Announcements

At the anniversary meeting of the Royal Astronomical Society, held on Feb. 12, Dr. H. Knox-Shaw, Radcliffe Observer, Oxford, was re-elected president of the Society, and the new members of Council elected were Mr. C. R. Davidson, Sir Arthur Eddington, Mr. John Evershed, and Dr. R. Stoneley.

It is announced in *Science* for Jan. 22 that the Richards Gold Medal for conspicuous achievement in chemistry has been awarded by the North-Eastern Section of the American Chemical Society to Prof. Arthur A. Noyes, director of the Gates Chemical Laboratory of the California Institute of Technology, Pasadena. The Richards Medal, which has thus been awarded for the first time, was established in 1929 to commemorate the contributions to chemistry by the late Prof. Theodore W. Richards, who was professor of chemistry in Harvard University. A trust fund of 10,000 dollars has been raised to endow the medal.

We have received a copy of a new catalogue of Zeiss surveying instruments from Messrs. Carl Zeiss, Mortimer Street, London, which includes details and illustrations of a number of levels, tachemeters, and theodolites, including the new Zeiss theodolite, type III. It is claimed that this instrument shows several improvements on previous models. The weight complete is only seventeen and a half pounds.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.—A lecturer in pharmaceuticals at the School of Pharmacy, Chelsea Polytechnic.—The Principal, Chelsea Polytechnic, Manresa Road, S.W.3 (Feb. 24). An assistant aircraft inspector under the Government of India.—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (Feb. 25). A lecturer and instructor at the Royal Air Force Electrical and Wireless School, Cranwell, with knowledge of alternating current work and its application to high-frequency engineering.—The Secretary, Air Ministry (Feb. 27). A full-time teacher in the Department of Mathematics and Physics of the West Ham Municipal College.—The Principal, West Ham Municipal College, Romford Road, Stratford, E.15 (Feb. 27). A head of the Mechanical Engineering Department of the Coventry Technical College.—The Director of Education, Council House, Coventry (March 3). A professor of philosophy in the University College of North Wales, Bangor.—The Secretary and Registrar, University College of North Wales, Bangor (May 14).

## Letters to the Editor

*[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]*

### Nomenclature for Lines in the $\beta$ -Ray Spectra of Radioactive Bodies

I HAVE found on several occasions considerable trouble and confusion occurring owing to the absence of any system of nomenclature for the lines in the  $\beta$ -ray spectra of the radioactive bodies. These spectra consist of a great number of lines formed by homogeneous groups of electrons, and in nearly every case they have been analysed by means of a magnetic field. The quantity, therefore, that is determined experimentally is  $H\rho = m_0 c \beta \sqrt{1 - \beta^2}$ , where  $\rho$  is the radius of curvature of the  $\beta$ -particle in a magnetic field of value  $H$ , and  $m_0$ ,  $c$ , and  $\beta$  have the usual significance. The quantity that is needed in most theoretical discussions is the kinetic energy of the  $\beta$ -particles, and this is obtained by calculation from  $H\rho$ . When it has been necessary to specify a particular line, it has been usual to give either the  $H\rho$  value or the energy, the latter being expressed sometimes in ergs and sometimes in electron volts. Thus, statements such as "the line  $H\rho$  1410" or "the line of energy  $1.529 \times 10^6$  volts" are current everywhere in the literature of the subject.

This might be practicable if these values of  $H\rho$  and energy for a particular line were likely to remain the same, but the reverse is the case. There is probably no  $\beta$ -ray line for which we know the  $H\rho$  value to one part in a thousand, and the calculation of the energy involves  $e/m$ , giving again a possibility of change in the final result. Almost every research on these spectra introduces slight improvements in the  $H\rho$  values, and this will probably be even more prominent in the future, now that the importance of these spectra in nuclear problems is apparent. We are therefore liable to meet statements about a line  $H\rho$  2916, with a footnote to the effect that this is the  $H\rho$  2913 measured by 'X' a year previously. Further, from the energies of the  $\beta$ -ray groups it is possible to determine the energy of the  $\gamma$ -ray responsible for them by conversion in one of the electronic states, and such  $\gamma$ -rays are referred to either by their energy values or wave-lengths, which are similarly subject to continual change.

Now, a  $\beta$ -ray line and a  $\gamma$ -ray are perfectly definite things, and it is highly desirable that each should be named. Any writer in the subject could then specify without ambiguity the  $\beta$ -ray line or  $\gamma$ -ray to which he is referring, and could state the  $H\rho$  or energy which he considers best to assign to it. The question of what nomenclature to adopt is a difficult one. Since one  $\gamma$ -ray can in principle produce as many  $\beta$ -ray lines as there are different electronic states in the atom, it might appear best to name the  $\gamma$ -ray, say,  $G$ , and then specify the  $\beta$ -ray group  $GK$  to mean that group due to conversion of this  $\gamma$ -ray in the  $K$ -level. I am not in favour of such a system, because the origin of all the  $\beta$ -ray lines is not known, and there is even a possibility of a change in the cases where we think we know the origin. I am, also, not even in favour of

attempting to group all the lines due to a certain radioactive body under one system of nomenclature, because there are numerous cases of  $\beta$ -ray lines of the existence of which we are quite certain, but where there is considerable doubt about which of two bodies actually emits them.

I think it would therefore be best to name on a common basis all those  $\beta$ -ray lines obtainable from the most usual sources. For example, I would suggest that all the lines obtainable from a source of thorium-B in equilibrium with its products thorium-C, thorium-C', and thorium-C'' be grouped together, radium-B plus the radium-C bodies would form another group, and so on. This may not be quite so convenient as endeavouring to effect a smaller subdivision, but it will avoid continual annoying changes in the naming of the weaker lines.

As regards the actual method of naming the lines, I suggest one that is based on intensities, but since we are deliberately using no quantitative data, any method which is proposed must depend on a certain amount of arbitrary choice.

However, I do not think it would be difficult to go through any spectrum and classify the lines relative to their neighbours, and as a basis of classification I would take the direct appearance of the photographic plate when suitably exposed for that region of the spectrum, and call the lines prominent, fairly prominent, or less prominent, irrespective of their

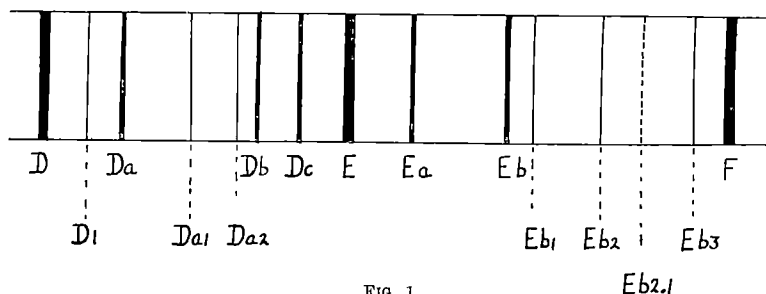


FIG 1

absolute intensities measured in the number of electrons in the line per unit exposure. The prominent lines I would name with capital letters in the order of increasing  $H\rho$  throughout the spectrum. The fairly prominent lines would be named by small letters but with reference to the prominent line next lowest in the  $H\rho$  scale—that is, the first line after the prominent line  $D$  would be called  $Da$  (see Fig 1) and the next  $Db$ , and so on, and then on the farther side of  $E$  the same type of line would be named  $Ea$ ,  $Eb$ , etc. For the remaining lines, numerals could be used within each division defined by the more prominent lines—thus, the significance of  $D1$ ,  $Da1$ ,  $Da2$  is obvious. I think it is a fair assumption that any new lines that are detected will be very faint, and they can easily be named by employing a decimal notation. For example,  $Eb2.1$  would mean a line lying between  $Eb2$  and  $Eb3$ . I think this system would work well if the initial assignment of letters is done so as to provide a large number of divisions in the spectrum.

I am indebted to Dr Feather for the suggestion that certain groups of capital letters should be assigned to definite regions of the spectrum, even if there are not sufficient prominent lines to use them all. A rough idea of the speed of a group would then at once be obtained from its name. For example, letters  $A$ - $F$  might be reserved for lines up to  $H\rho$  1500,  $G$ - $K$  for  $H\rho$  1500-2500,  $L$ - $P$  for  $H\rho$  2500-4000,  $Q$ - $U$  for  $H\rho$  4000-7000, and  $V$ - $Z$  for above  $H\rho$  7000. A  $\gamma$ -ray could, of course, be named in a natural manner



by prefixing  $\gamma$  to the name of the most intense  $\beta$ -ray line for which it was responsible

I am convinced that this question, while perhaps at first sight trivial, is, on the contrary, urgent and important, and that a suitable decision now will save a great deal of trouble in the future. I do not lay great stress on the particular method I have proposed, and should be only too willing to adopt any other method that seems likely to offer more advantages

C. D. ELLIS

Cavendish Laboratory, Cambridge,  
Jan 15

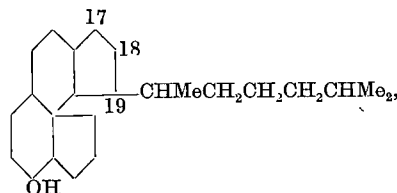
### Crystal Structures of Vitamin D and Related Compounds

I HAVE had the opportunity of examining by X-rays the crystals of ergosterol and certain of its irradiation products, recently described by a team working at the National Institute for Medical Research.<sup>1</sup> Though the results are only preliminary, they seem of sufficient interest to warrant publication at this stage. Five substances, all of composition  $C_{27}H_{41}OH$  or  $C_{27}H_{43}OH$ , have been examined, with the results shown in the accompanying table.

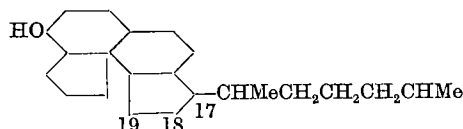
The most striking features of the crystals are their essential similarities of properties and the simple

more than one molecular species and is purely of geometrical intermolecular origin.

2 The molecule of ergosterol and its photo-derivatives has the approximate dimensions  $5 \text{ \AA} \times 7.2 \text{ \AA} \times 17\text{--}20 \text{ \AA}$ . These form a double layer similar to those of long-chain alcohols and acids. Such dimensions are difficult to reconcile with the usually accepted sterol formula



which would lead to a wider and shorter molecule, but agree much better with one where the carbon chain is attached to atom 17 in ring IV,



3. The rings lie approximately in the  $bc$  plane,

| Substance                                     | $a$  | $b$  | $c$  | $\beta$ | $c \sin \beta$<br>$=d_{001}$       | Space Group     | No of Mol per Cell | No of Mol in Asymmetric Unit | Orders of Basal Plane, Estimated Intensities |    |    |   |    |    |    |    |    |    |
|-----------------------------------------------|------|------|------|---------|------------------------------------|-----------------|--------------------|------------------------------|----------------------------------------------|----|----|---|----|----|----|----|----|----|
|                                               |      |      |      |         |                                    |                 |                    |                              | 1                                            | 2  | 3  | 4 | 5  | 6  | 7  | 8  | 9  | 10 |
| Ergosterol                                    | 9.75 | 7.4  | 39.1 | 65°     | 35.40                              | $C_{27}^2-P2_1$ | 4                  | 2                            | vvs                                          | vs | mw | a | vw | mw | s  | vw | m  | vw |
| $\alpha$ -Dihydroergosterol and ethyl alcohol | 30.8 | 7.4  | 43.1 | 53      | 34.5                               | $C_{27}^3-C2$   | 12                 | 3                            |                                              | vs | mw | a | vw | mw | s  | a  | m  |    |
| Calciferol                                    | 20.8 | 7.15 | 38.5 | 68      | 35.65                              | $C_{27}^2-P2_1$ | 8                  | 4                            | vvs                                          | vs | s  | a | vw | mw | ms | vw | ms |    |
| Pyrocalciferol                                | 20.2 | 7.35 | 40.0 | 63      | 35.8                               | $C_{27}^3-C2$   | 8                  | 1                            |                                              | w  | a  | a | a  | ms | w  | m  | w  | m  |
| Lumisterol                                    | 20.3 | 7.25 | 20.4 | 60      | 17.8<br>$=\frac{1}{2} \times 35.6$ | $C_{27}^2-P2_1$ | 4                  | 2                            |                                              |    |    | w | a  | s  | a  | m  | a  | w  |
| Cholesterol                                   | 16.4 |      |      |         | 33.3                               | $C_{27}^1-P1$   |                    |                              |                                              | vs | a  | a | a  | w  | ms | vw | ms | w  |

N B—Letters for intensities vs, very strong, mw, medium weak, etc

relation between their unit cells. All the substances except lumisterol occur in platy crystals of a long-chain paraffinoid type. All are monoclinic and show a distinct tendency to elongation along the  $b$ -axis (In lumisterol the crystals are fine needles with  $b$  as needle axis). All are optically positive with (010) as optic axial plane and the fast direction  $\gamma$  inclined at a moderate angle to the  $c$  face. All have the same  $b$  axis of  $7.2 \text{ \AA}$  and their  $a$  and  $c$  axes are simple multiples of  $10 \text{ \AA}$  and  $20 \text{ \AA}$  respectively. The spacing of the  $c$  plane is remarkably constant at  $35.5 \text{ \AA}$ , agreeing with the value found by K. Wejdling and E. Backlin.<sup>2</sup> It differs significantly from that of cholesterol, which was examined for comparison. Lumisterol has a halved  $c$  spacing, and  $\alpha$ -dihydroergosterol, owing to the presence of alcohol of crystallisation, deviates from the others.

From these observations certain conclusions can be drawn.

1 The unit cell of the molecular compound calciferol-pyrocalciferol contains four molecules of each kind, which is the number the symmetry demands for the space group  $C_{27}^3-C2$ . This proves either that calciferol is a simple substance or that it contains other substances indistinguishable by X-rays. The former conclusion is far the more probable. The association of molecules found in the other cases consequently does not show that any of them consists of

that of the larger refractive indices  $\beta\gamma$ , and their width  $7.2$  is approximately constant in all the compounds. This is borne out by the observations of sterol films by N. K. Adam,<sup>3</sup> who finds the molecule area of  $36 \text{ sq \AA}$  for ergosterol, as against  $35 \text{ sq \AA}$  in the solid crystal.

4 The differences between the compounds is due to a difference in the side groups or linkages in the rings, leading to a different form of association in the solid and to a small but distinct redistribution of scattering matter along the chain lengths, as shown by the intensities of the  $c$  plane spectra. The greatest similarity is shown between ergosterol and calciferol, the chief difference being a double association of molecules in the latter case. It may be significant that while the basal plane intensities of ergosterol and dihydroergosterol are practically indistinguishable in spite of the notable difference in spacing, those of ergosterol differ from them particularly in the third and ninth orders. This would seem to indicate that the change had affected the carbon skeleton, not merely the position of double bonds in the molecule. In lumisterol and pyrocalciferol the change in intensities is so much greater that the resemblance is almost obliterated. It is doubtful, however, in view of the extreme complexity of the molecules, whether any conclusive evidence of the actual intra-molecular change can be found by X-rays alone. The most

hopeful method would seem to be the examination of the ultra-violet absorption and Raman spectra of single crystals with polarised light at liquid hydrogen temperatures

J D BERNAL

Mineralogical Museums,  
Cambridge, Feb 2

<sup>1</sup> F A Askew, R B Bourdillon, H M Bruce, R K Callow, J L Philpot and T A Webster, *Proc Roy Soc, B*, 109, 488, 1932. See also NATURE, 128, 758, Oct 31, 1931. I am indebted to Dr Callow for the actual specimens and private communication giving later values

<sup>2</sup> *Acta Radiologica*, 11, 166, 1930

<sup>3</sup> *Proc Roy Soc, A*, 126, 25, 1930

### Distribution of Electrons in the Aromatic Nucleus and the Early Stages of Aromatic Substitutions

IN a recent memoir<sup>1</sup> E Huckel has made an interesting attempt to apply modern mathematical and physical conceptions of the electron in valency bonds to an *a priori* deduction of the distribution of negative electricity in the benzene ring and ultimately to the development of a theory of orientation in aromatic substitutions. The paper has been very favourably received by physicists and also by many physical chemists, who have no doubt assumed that the *dénouement* in its main outlines is in harmony with the views of organic chemists. This is, however, not the case, so far as we are concerned, we expected conclusions to be reached which are the opposite of those arrived at by Huckel. Where this author postulates an excess of electrons we consider there is a defect, and vice versa.

It should be stated that we are confining our attention to the reactive positions, and the remarks made in this note are not intended to apply to the circumstances of any of the other carbon atoms in the nucleus. Thus there is little chemical evidence for the alternation proposed by Huckel, even if all the signs are inverted. The theory of Huckel requires that, of two carbon atoms, the one which is the more deficient in electrons will be the more prone to undergo substitution (for example, nitration, sulphonation, or halogenation). The mechanism propounded is initially extrusion of a proton by the relatively *positive* centre, followed by attack of the vacant position by the reagent. On the other hand, we say that the reagent (of the electron-seeking kind, as in the processes specified) attacks the centres of *electron excess*, and that this is followed by the expulsion of the proton.

Our theoretical systems, though not identical in every respect, have been found successful in correlating certain important generalisations in organic chemistry with the changes observed in the properties of inorganic compounds as the charge on the nucleus of the central element alters  $B \rightarrow C \rightarrow N$ ,  $P \rightarrow S \rightarrow Cl$ . They have also proved useful in the interpretation of organic chemical phenomena of the most varied types.

The arguments that could be brought to bear on the present subject are accordingly very numerous, and it will suffice to mention the following three points.

(1) Any theory of aromatic substitution is inadequate if it fails to take account of the fact that the influence of groups on the course taken by substitution in the aromatic series can be perfectly correlated with the effects of the same groups on the orientation of additive reactions of non-aromatic unsaturated substances. Such reactions obviously obey the same fundamental laws as those that govern aromatic substitution and yet the *expulsion of a proton does not occur at any stage of the process*. We claim that in both cases the reagent seeks the centres of greater electronic density.

(2) From a study of the relative strengths of acids and bases, it is known that certain substituents have the effect of loosening the grip of a molecule on a proton, others tighten it. Clearly, in Huckel's theory the groups that make an acid stronger and a base weaker should, when introduced into the benzene molecule, facilitate the process of further substitution. Thus nitrobenzene should be *more* reactive than benzene, whereas toluene should be *less* reactive. Actually the reverse is the case, and circumstances, which from all analogies must assist in the process of extrusion of protons, do not render aromatic substitutions more facile, but, on the contrary, they make them much more difficult.

(3) Even in aromatic substitutions, the proton which is expelled may be detached from a part of the molecule remote from the point of attack of the reagent and of attachment of the new substituent. An example is the perhalogenation of certain phenols and in general all that numerous class of reactions leading to blocked hydroaromatic types. In these cases it is not the atom suffering loss of a proton that receives the substituent, and therefore Huckel's theory could not be applied without such modifications as would amount to a reversal of the principle.

Without, therefore, going into the minutiae of the special organic reactions concerned, we venture to think that the above considerations render the view of Huckel untenable.

Unfortunately, the postulated distribution of electrons in the nucleus must stand or fall with the theory of substitutions, and we therefore assume that some error has crept into the discussion, the mathematical physics of which we are not competent to criticise.

The above remarks apply only to the course of ordinary aromatic substitution, which most organic chemists agree in attributing to the active intervention of unsaturated systems of two or more carbon atoms, substitution in saturated carbon compounds is quite a different phenomenon and may well be preceded by the loosening of the proton replaced. In this connexion the suggestion is not at all novel. Furthermore, cases in which aromatic substitution occur with great difficulty may perhaps be correctly described as of saturated hydrocarbon substitution type, a possible example being the conversion of *m*-dinitrobenzene into trinitrobenzene.

Nevertheless, the theory of substitutions in saturated compounds has not yet been satisfactorily treated, and we do not claim that the idea of incipient proton dissociation is proved in any one example, there are too few reliable data and the evidence is conflicting.

The object of this note is to direct attention to our opinion that the conclusions reached by E Huckel regarding the distribution of electrons in benzene derivatives and the mechanism of substitution are quite unacceptable.

A LAPWORTH

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R. ROBINSON

The Dyson Perrins Laboratory,  
Oxford

<sup>1</sup> *Z Phys*, 72, 310, 1931

### Surface Tension of Soap Solutions

PROF MAHAJAN's latest letter<sup>1</sup> and his paper<sup>2</sup> suggest that he has entirely misunderstood, not only my own work and the conclusions derived from my experiments, but even the very meaning of the terms dynamic and static surface tension.

The methods used by Prof Mahajan for the

measurement of surface tension are quite incapable of giving a true value of dynamic surface tension, as this requires the measurements to be made in about 0.1 second, or less, especially when small and rapidly moving molecules, such as those of sodium oleate, are concerned. Therefore, what Prof Mahajan terms 'dynamic values' are nothing but *semi-static* values, more or less close to the real static value corresponding to the veritable equilibrium. I have published the results of certain experiments made on solutions of pure sodium oleate<sup>3</sup> at the concentrations 1/25,000, 1/50,000, 1/100,000, which show very plainly that, when the surface tension is measured very rapidly (ten successive determinations were made in the first minute), the dynamic value for a solution in which the active molecules are as near as possible of a homogeneous distribution, is very near that of pure water. Had it been possible to measure the surface tension in the first one hundredth of a second or so, the value would have been identical with that of water. As it was, the following values were obtained:

| Concentration                        | 1/25,000 | 1/50,000 | 1/100,000 |          |
|--------------------------------------|----------|----------|-----------|----------|
| Dynamic (immediately after stirring) | 68.0     | 71.0     | 71.0      | dynes/cm |
| After 15 sec                         | 64.0     | 70.0     | 70.0      | 22°      |
| " 30 "                               | 58.0     | 68.0     | 69.0      |          |
| " 1 min                              | 42.0     | 63.0     | 68.0      |          |
| " 2 "                                | 39.0     | 52.0     | 64.0      |          |
| " 3 "                                | 38.0     | 41.0     | 61.0      |          |
| " 5 "                                | 37.0     | 37.0     | 55.0      |          |
| Static value after 12 min            | 36.6     | 35.0     | 32.1      |          |
| After 2 hours                        | 36.6     | 35.0     | 32.1      |          |

It is obvious that, as the concentration increases, the initial value (dynamic) will be lower. It requires less time for the molecules to become adsorbed in the surface layer, as they are closer to it, and in larger number. Consequently, if we deal with solutions of, say, 1 per mille, or 1 per cent, the measurement must be done in a small fraction of a second in order to correspond to that of water, as the 'drop' is very rapid. I hope I have made it clear that the important drop in surface tension, which, for technical reasons, can only be followed step by step in the case of dilute solutions, is due to the Gibbs-Thomson adsorption of active molecules in the surface layer.

When Prof Mahajan mentions surface tension values of the order of 30-40 dynes, he cannot use the term 'dynamic', as most, if not all, of the adsorption in the surface layer has already taken place. What is meant by 'time-drop due to adsorption' is precisely the phenomenon which has brought the surface tension down from 73 dynes to a value around 30 dynes.

What Prof Mahajan therefore observes is an additional phenomenon, of small amplitude, which takes place *after* the Gibbs-Thomson adsorption, which Prof Mahajan seems to ignore altogether, has played its part.

I take this opportunity to advise Prof Mahajan against quoting the values of surface tension to the third decimal point. After more than ten years of experience with all possible methods of measurements, I have come to the conclusion that the second decimal point is generally dubious when dealing with pure liquids, and is absolutely meaningless in case of colloidal solutions.

P. LECOMTE DU NOUY

Institut Pasteur,  
Paris

<sup>1</sup> NATURE, 129, 133, Jan 23, 1932

<sup>2</sup> Ind. J. Phys., 6 (2), p. 147

<sup>3</sup> Du Nouy, *J. de Phys. Radium*, 6 (VI), pp. 145-153, and "Équilibres superficiels des solutions colloïdales" (Masson, Paris), p. 40

### Stokes's Formula in Geodesy

STOKES in his "Collected Papers", vol 2, p 168, gave a very elegant formula, giving elevation  $N$  of geoid above its reference spheroid in terms of  $g$ -anomalies.

The formula is  $N = \frac{R}{G} \int_0^\pi (\Delta g)_\psi F d\psi$ , where

$$F = \frac{1}{2} \left\{ \operatorname{cosec} \frac{\psi}{2} + 1 - 6 \sin \frac{\psi}{2} - 5 \cos \psi - 3 \cos \psi \log \sin \frac{\psi}{2} \left( 1 + \sin \frac{\psi}{2} \right) \right\} \sin \psi,$$

$\psi$  being the angle between current point and the point at which rise has to be calculated. The formula has been neglected so far probably on account of paucity of  $g$ -observations, as it requires for calculation of  $N$  at one place, the values of  $g$ -anomalies all over the globe. Recently, however, it has been brought into prominence by articles by V Meinesz<sup>1</sup> and by W D Lambert<sup>2</sup>.

The former goes so far as to say that it can be used for giving local deviations of geoid. While one may be able to use it to get a general idea of elevation of a broad feature of continental extent, and with luck to get differential elevations of two close points above spheroid, I believe it will never be possible to use it for getting absolute elevations.

For computational purposes it is best to divide the earth into concentric rings round the station, and then we get

$$N = \frac{R}{G} \Delta \psi_0 \Sigma F_1(\psi) \Delta g_M,$$

where  $\Delta \psi_0$  is the breadth of a ring,  $\Delta g_M$  is the mean value of  $\Delta g$  in that ring, and  $F_1(\psi)$  is the mean value of  $F(\psi)$  in that ring.

From this the effect of the various zones for  $\Delta g = 0.001$  cm/sec<sup>2</sup> is given in Table 1.

TABLE 1

| Zone  | $N$ in ft | Zone    | $N$ in ft |
|-------|-----------|---------|-----------|
| 0°-2° | +1        | 70°-80° | -4        |
| 2-4   | +1        | 80-90   | -4        |
| 4-6   | +1        | 90-100  | -3        |
| 6-8   | +1        | 100-110 | -1        |
| 8-10  | +1        | 110-120 | 0         |
| 10-20 | +4        | 120-130 | +1        |
| 20-30 | +3        | 130-140 | +2        |
| 30-40 | +1        | 140-150 | +2        |
| 40-50 | -1        | 150-160 | +2        |
| 50-60 | -3        | 160-170 | +1        |
| 60-70 | -4        | 170-180 | 0         |

The figures in this table are correct to the nearest foot.

In actual practice, to get mean  $\Delta g$  in each zone, we will have to divide these zones into smaller compartments, and calculate the mean  $\Delta g$  from each of the compartments and then deduce the mean  $\Delta g$  with its probable error for the whole zone. While near the station the probable error of the mean  $\Delta g$  in our zones may be of the order of 0.005, in outer zones it may easily attain a magnitude of 0.01. These probable errors will enable us to assess the maximum error in our estimated  $N$ . A probable error of 0.01 in zone 60°-70° will mean that our estimation of the share of that zone in producing rise of geoid may be wrong by, say, 40 ft. A systematic error of 0.01 in zones from 40°-100°, and of -0.01 in zones from 130°-170° would vitiate the results hopelessly. In no case could one say with any reasonable certainty that  $N$  at a station was correct to even 100 ft or 200 ft.

For differential purposes, however, the situation is different. The effect of error in each compartment,

especially for the distant zones, is practically the same for two nearby stations. If, then, we have got a map of the world with our estimated  $\Delta g$ 's, we could by suitable templates in a manner analogous to Hayford's isostatic reductions read off the mean  $\Delta g$  for our rings, and probably get a reasonable answer for the differential heights of the points in a local area.

Hence, although the validity of the formula, which was doubted by Helmert, is unquestionable, as V Meinesz proves, it must be realised that for countries of such wide extent as India, where the elevations of geoid above its spheroid of best fit, as indicated by plumb line deflexions, are of the order of only 20 ft., it is not likely to be of much use, as the uncertainty of the value of  $\Delta g$  in the outer zones makes it impossible to attain this order of accuracy.

B L GULATTEE

Geodetic Branch, Survey of India,  
Dehra Dun, Jan 7.

<sup>1</sup> *Konink Acad. von Wetenschappen te Amsterdam*, vol 31  
<sup>2</sup> *Bull. Geod.*, 1930

### The Zodiacal Light and the Luminosity of the Night Sky

THE spectrum of the zodiacal light was photographed by Fath,<sup>1</sup> who found that it showed the Fraunhofer line *G* and a blend of *H* and *K* lines, and did not show indication of any bright line. He concluded that zodiacal light is reflected sunlight. I have recently obtained photographs of the spectrum of zodiacal light on very clear nights at Poona (lat 18° 31' N) with an F/1.5 glass spectrograph constructed locally (with the kind assistance of Mr S P Venkateswaran). Using Mimosa extreme orthochromatic plates (H and D for light from half-watt lamp 2600), which I have found to be the most rapid for this work, the spectrograph is sufficiently powerful to bring out the night sky line 5577 Å in one hour's exposure with a slit-width of 0.7 mm.

When the spectrograph is turned towards the zodiacal light at an angle of about 25° above the horizon and successive photographs (each exposure lasting one hour or one hour and a half) taken on the same plate, beginning when the sun is about 20° below the horizon, it is found that the line 5577 Å comes out strongly, and with the decrease of intensity of the zodiacal light the line also becomes fainter. The intensity of the light decreases to about a third between 8 P.M. and midnight in December, and remains more or less steady thereafter.

It may be mentioned that the brightness of the continuous background in the zodiacal light is too small to affect the above conclusion. In the northern and southern skies, the intensity of the green line is more or less steady, with some slight variations which are under investigation. The midnight maximum noticed by McLennan and collaborators, and by Lord Rayleigh, is not unambiguously evident in these latitudes.

The above observations raise the question whether the luminosity of the night sky and of the zodiacal light are not identical in origin. The presence of the green line 5577 Å in the zodiacal light, and hence of atomic oxygen at great distances from the earth, are particularly interesting from the point of view of theories of the origin of zodiacal light.<sup>2</sup>

Photometric measurements to decide the issues raised above are in progress.

K R RAMANATHAN

Ganeshkurd Road,  
Poona 5, Jan 1

<sup>1</sup> Fath, *Luck Obs. Bull.*, 5, 141, 1909  
<sup>2</sup> Hulbert, *Phys. Rev.*, 35, 1098, 1930

No 3251, Vol. 129]

### Polish on Metals

WE are much interested in Mr French's letter in NATURE of Jan 30, as we ourselves have just constructed an electron camera for the examination of the polish on metals and similar problems. In an earlier paper by Prof G P Thomson<sup>1</sup> it has been stated that no pattern was detected from polished metal surfaces, and it was felt at the time that this result was not in accord with other work then proceeding in this laboratory. It had been found<sup>2</sup> that so-called amorphous substances, such as glasses of widely differing chemical compositions, gave rise to very definite X-ray diffraction patterns which bore strong similarities to the line patterns of corresponding crystalline substances. This led us to the view that, while glasses may contain some material in a truly amorphous form, the greater number of atoms are built up in the form of exceedingly small crystals, probably not exceeding 10<sup>-6</sup> cm in size. At the same time, small differences were noted between the spacings of the diffuse bands of the vitreous substance and those of the corresponding completely crystalline substance.

It had already been shown theoretically<sup>3</sup> that the atoms in the surface layer of a crystal have a slightly

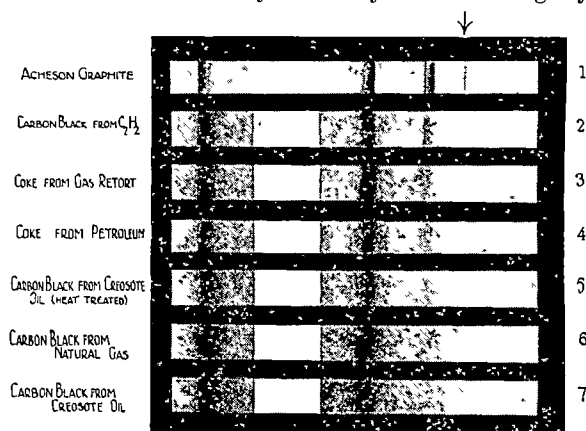


FIG 1—X-ray photographs of graphite and 'amorphous' carbons

different spacing from those in the layers beneath, and Prof Lennard-Jones was then able to show<sup>4</sup> that the spacings of exceedingly small crystals, of the size of those found in glasses, could differ from those of the ordinary crystalline material by several per cent.

In view of this, and assuming that Mr French's bands are of very similar spacings to two of the lines of the ordinary copper pattern, a slightly modified interpretation of his results becomes possible. When a metallic surface is polished the crystals break down into smaller units, causing the diffraction pattern to become slightly diffuse. As the polishing proceeds, the crystals break up into still smaller units, so that the interplanar spacings also alter. At the same time, no doubt, a certain amount of truly amorphous material may be produced. This would tend to fog the diffraction pattern still more, so that the weaker bands would become very indistinct, if not impossible to see.

It does not necessarily follow that because the diffraction pattern of the polished surface does not contain the same number of bands as the crystal pattern does lines, that the two lattices are not essentially the same. This point is emphasised in the accompanying series of X-ray photographs of graphite and 'amorphous' carbons (Fig 1). It is not meant to discuss these in detail here, but it will be seen that

the outer diffuse line of photograph (2) has almost disappeared in (3) and cannot be distinguished in any of the remaining photographs\*. Further, measurements show that as the crystal size decreases, the basal plane (002) spacing increases, while the (100) spacing decreases at a lesser rate. This general trend can be seen in the photographs. Such changes of spacing had already been noticed,<sup>5</sup> but we think the present series of photographs gives rather a convincing demonstration of the gradations between a truly crystalline substance and one which would formerly have been called amorphous. It must also be remembered that the shape of the ultimate crystallites of the polished surface will have a bearing on the relative intensities of the bands.

J. T. RANDALL  
H. P. ROOKSBY

Research Laboratories of the  
General Electric Company, Ltd.,  
Wembley, Feb. 2

- <sup>1</sup> G. P. Thomson, *Proc. Roy. Soc. A*, **128**, 649, 1930.  
<sup>2</sup> J. T. Randall, H. P. Rooksby, B. S. Cooper, *Z. Krist.*, **75**, 196, 1930.  
<sup>3</sup> J. E. Lennard-Jones and B. M. Dent, *Proc. Roy. Soc. A*, **121**, 247, 1928.  
<sup>4</sup> J. E. Lennard-Jones, *Z. Krist.*, **75**, 215, 1930.  
<sup>5</sup> H. H. Lowry and R. M. Bozorth, *J. Phys. Chem.*, **32**, 1524, 1928.  
\* The line referred to is positioned beneath the arrow at the top of the figure.

### Mechanism of Racemisation

IN some work shortly to be published, we have shown that the racemisation of Rochelle salt by caustic soda is accompanied, and probably conditioned, by complex formation. It was previously observed by Thomsen,<sup>1</sup> and confirmed by Winther<sup>2</sup> and by ourselves, that the rotation of sodium tartrate is reduced by the addition of alkali. We have, therefore, in continuation of our work on racemisation, investigated the behaviour of the specific rotation of Rochelle salt with increasing concentrations of alkali, and we find that the specific rotation of Rochelle salt eventually becomes strongly negative. In other words, the complex is itself *lævo*-rotatory, and the progressive reduction in the rotation is due to increasing formation of complex with addition of alkali. The rotation changes sign at an alkali concentration of 10 *N* caustic soda (approx.). It should be stressed that these changes of rotation are prior to any racemisation, in the ordinary sense of the term, the rotations being quite stable in the strongest alkali, provided the solutions are kept at room temperature.

If, as we suppose, the complex is produced by the entrance of sodium atoms in place of the hydrogens of the radicle OH-groups, it appears that interchange of groups takes place, immediately on dissolving in alkali, if we accept the usual hypothesis of the mechanism of racemisation. On this view, the subsequent process of heating to produce racemisation is merely one of stabilisation to prevent the converse interchange of groups on acidification. This view meets with the following difficulties: (1) it is difficult to see in what this process of stabilisation consists, (2) under certain conditions, the heating should lead to an inversion, and not a racemisation. In our opinion, the stereochemical conception of optical activity as a static phenomenon is not entirely satisfactory.

ALAN NEWTON CAMPBELL

ALEXANDRA JEAN ROBSON CAMPBELL

Department of Chemistry,  
University of Manitoba,  
Winnipeg, Jan. 16

<sup>1</sup> *J. prakt. Chemie* (2), **34**, 83

<sup>2</sup> *Z. physik. Chem.*, **56**, 465, 1906

### Measuring the Surface Area of Living Animals

A NEW method of estimating the surface area of living animals used in metabolism work seems likely to be of interest to many biological workers outside the agricultural sphere. Such a method has recently been developed by me in this laboratory.

Although the animals immediately concerned are pigs, the method is applicable generally to all animals not encumbered with a thick shaggy coat, and consists, essentially, in the estimation of the approximate value of the integral  $\int P dx$  over the surface of the animal, where  $P$  is the perimeter in a plane perpendicular to the axis of  $x$ . In the case of pigs, it appeared satisfactory to take  $P = k\pi(a+b)$ , assuming the cross section elliptical for the head and body. Here  $k$  is a constant which indicates the departure from perfect ellipticity and varies somewhat in value at different parts of the body, while  $a$  and  $b$  have their usual connotations in the approximate formula for the perimeter of an ellipse. The approximate integration is then made by Simpson's rule, the values of the ordinates  $a$  and  $b$  for different values of  $x$  being read off directly from scale photographs, one taken from the side and the other from directly above the animal. The ears, legs, and tail are estimated separately.

A consideration of the various corrections required and of the errors involved leads to the conclusion that the total error in the method, when all precautions are taken, amounts to not more than 2.0-2.5 per cent, varying a little with the individual animal, in the case of pigs.

For other animals, the constant  $k$  and the errors would have to be determined, but there seems reason to suppose that—except perhaps in the case of human beings, for whose superficial area a mass of data is available—a very considerable increase in accuracy may be expected by the employment of the method outlined, in preference to the use of empirical formulae depending on weight, height, length, or any or all of these. Experience shows that such formulae are all liable to errors of the order of 10 per cent when applied to animals of the same species other than the ones actually used by the experimenter in determining the formula.

A full account of the method will appear in the April issue of the *Journal of Agricultural Science*.

THOS. DEIGHTON

School of Agriculture,  
Cambridge, Jan. 28

### Crystal Structure of $\beta$ -Zirconium

FROM the temperature variation of the resistivity, the thermal dilatation and the thermionic emission, C. Zwicker<sup>1</sup> has deduced that zirconium is transformed into another modification between 1150° K. and 1430° K. Quite recently, the transition point was accurately measured by R. Vogel and W. Tonn<sup>2</sup> from a study of the cooling curve. They found it to be  $862^\circ \pm 5^\circ$ . The crystal structure of the high temperature modification ( $\beta$ -zirconium) has been determined by us to be cubic body-centred, with two atoms of the metal in an elementary cube, the side-length of which at a temperature in the neighbourhood of the transition point is 3.61 Å. The experimental details and the high temperature vacuum camera used will be described elsewhere (*Z. anorg. allgem. Chem.*).

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<sup>1</sup> *Physica*, **6**, 361, 1926

<sup>2</sup> *Z. anorg. allgem. Chem.*, **202**, 292, 1931

## Research Items

**Colombian Archaeology**—An account by Mr J Alden Mason of a year's field work of an expedition of the Field Museum of Natural History, Chicago, to the Santa Marta area of Colombia in 1922-23 (*Pub.* 304, Anthropological Series, vol 20, No 1) describes the examination and excavation of a number of sites in what was once the habitat of the long extinct Tairona Indians. Previously their culture was practically unknown. The area is an island mass rising from tropical coast-land to eternal snow, a system entirely independent of the adjacent Andes. The sites investigated fall into three classes, coastal, foothill, and high mountain. Of the coastal sites, Gairaca provided interesting evidence as to burial customs. It was evidently primarily, if not mainly, an interment site, though it appears to have been occupied seasonally. The interments all date from approximately the same period, and there is no evidence of post-Columbian occupation. The urn burials were secondary—that is, they represent the reinterment of disarticulated bones, but occasionally primary burials were found. Pet animals may have been sacrificed. Implements and ornaments were sometimes enclosed in the burial urns, but more often in smaller urns or in the surrounding soil. Food was also enclosed in small pottery vessels. The pottery is of two types, a coarse red ware with appliqué relief, and thin black polished vessels with incised ornament or moulded relief. The two are evidently contemporaneous. On a site at Nahuange some interesting artefacts were found in association with skeletal remains and pottery vessels. These included six or eight artistic, but highly stylised, heads of crocodiles made of a large univalve mollusc shell, crescentic pendants of shell, tubular beads and other beads of shell, carnelian, etc., two plaques of gold-copper alloy and other gold objects, and ornaments made of univalve shells which may have been used as rattles on clothing. A number of pictographs of a unique character and architectural remains were found at the foothill sites. The material objects found and the scientific deductions will be dealt with in two subsequent reports.

**British Migration Elucidated by Ringing Methods**—H F Witherby and E P Leach have continued their valuable compilation of all the records of birds which, ringed in the British Islands, have been recovered abroad, and of birds which, ringed abroad, have been found in these islands (*Brit Birds*, Dec 1931, p 174). The maps upon which the records of particular species are shown bring out many points in a clear way. The lapwing performs westward and southward movements, British shores being replenished by birds bred in Denmark, Sweden, and Holland, while British native birds have been recovered only south of these islands from northern France, along the west coasts of France, Spain, and Portugal to North Africa. On the other hand, the lists show that mallard and teal which have been bred in the British Isles move east and north, and in their case there is no evidence of a southward migration.

**Habits of a Japanese Limpet**—The limpets (*Acmæa dorsuosa*) of Mutsu Bay show seasonal groupings, the spring to autumn period (April to September) being a season of congregation, when individuals appear in groups above high-water mark, whereas from mid-September to March the groups are dispersed (Noboru Abe *Science Reports, Tôhoku Imp Univ*, vol 4, Sept 1931, p 403). This species has the power of both backward and forward locomotion, and its greatest rate of progress is about 2.8 cm a minute, less than

one-third of the speed attained by its congener *A. schrenckii*. The larger limpets have definite spots to which they return after wandering, but such 'homes' do not appear to be permanent. The force of adhesion of the foot of *A. dorsuosa* is equivalent to 373 gram or more for each square centimetre of the surface of the foot.

**British Palmate Orchids**—H Cary Gilson, in collecting and collating much scattered data referring to the British palmate orchids, has produced a useful summary of information on this highly critical group of plants (*Winchester College Nat Hist Soc Publications*). Descriptions of species and varieties occupy the first part of the paper, and the conflicting opinion on the status of *O. latifolia* are summarised. Hybrid are not described, but many are well illustrated by photographs. The second part of the work deals with the palmate orchids of the Winchester district, together with the author's own views on the constitution of *O. latifolia*, which he suggests may have arisen through the hybrid *O. maculata* (agg.)  $\times$  *protermissa* by repeated back-crossing of the progeny with one parent followed by selfing to give a small proportion of homozygous plants. The suggestion, whilst providing an explanation of some of the observed facts connected with the polymorphism of *O. latifolia*, is quite hypothetical, and emphasises the need for cytological and genetical examination of this and related orchids.

**Geology of East Greenland**—The geological work of the Cambridge Expedition to East Greenland in 1929 has been described in an important paper by M M L Parkinson and W F Whittard (*Quart J Geo Soc*, pp 650-74, 1931), with some excellent maps and illustrations. The work was concentrated mainly on the elucidation of certain tectonic problems in the pre-Old Red Sandstone rocks of the area about the Franz Josef and King Oscar Fjords. The outstanding fact in the Palaeozoic geology of the region is the triple repetition of belts of sedimentary and metamorphic rocks, and its explanation appears to be closely related to the Caledonian movements. In pre-Cambrian times a complete trough of deposition lay north and south between Laurentia and Baltica. In the East Greenland mountains the shallow-water sediments then deposited in the western border of this trough are preserved. In Cambrian times two or more geanticlines of pre-Cambrian metamorphic rocks which had appeared earlier continued to develop, while the intervening basins harboured shallow-water sediments with shelly faunas. Wedges of metamorphic and sedimentary rocks advanced westwards up thrust planes. The main pressure persisted until at least the Middle Ordovician and possibly the Silurian. The Central Metamorphic Complex represents the most westerly of these geanticlines, while the most easterly is the Eastern Metamorphic Complex.

**The South Sandwich Islands**—Little has been added to the knowledge of these subantarctic islands since their discovery by Cook in 1775 and the visit by Bellingshausen in 1820 until *Discovery II* spent some days at the group in 1930. In a lecture to the Royal Geographical Society on Dec 14, Dr S Kemp gave an account of the main discoveries. All the eleven islands are of volcanic formation dating probably from tertiary times. Five still show signs of activity with craters and fumaroles emitting steam and vapour. Three others retain some warmth, and the remainder



three are more or less heavily glaciated. There is considerable evidence of lost land areas around some of the islands. The introduction of echo-sounding into this area of the South Atlantic has thrown light on the relation of the group to other land areas though more work must be done before the problem is finally solved. There is strong evidence of a submarine ridge extending between South America and the South Sandwich group via the Burdwood Bank, the Shag Rocks and South Georgia, but the continuance of the ridge between the South Sandwich Islands and the South Orkneys is not so well established. East of the islands there is an extensive curved deep falling to at least 4421 fathoms. These facts support Suess's theory of the South Antillean arc, which is further supported by the occurrence of typical Andean lavas in Thule Island, the southernmost of the group.

**Mapping of the Southern Ocean**—A chart of the Southern Ocean, from long  $50^{\circ}$  S to  $73^{\circ}$  S and from lat  $20^{\circ}$  W to  $100^{\circ}$  E, has been worked out on Mercator's projection by the Norwegian Geographical Institute, the scale being 1 4,000,000 at  $60^{\circ}$  S (Publikasjon nr 10 fra Kommandør Chr Christensens Hvalfangstmuseum, Utarbeidet for Hvalangernes Assuranceforening, Sandefjord). A considerable number of fresh soundings obtained by Norwegian antarctic whaling expeditions are included. A plan (1 100,000) is given of Bouvet Island, which was the subject of diplomatic exchanges some years ago and was ceded by Great Britain to Norway in 1928 as an act of grace.

**A Sensitive Barograph**—We have received from Messrs Negretti and Zambra, the well-known scientific instrument makers, a specimen record of the variations of atmospheric pressure during the week Jan 18-25, 1932, obtained with the aid of a micro-barograph which gives a record on a scale of five inches to an inch of mercury. This instrument is numbered M 2071 in the firm's catalogue of standard meteorological instruments, and is styled the Precision Recording Barometer. In order to obtain sufficient control to overcome the friction involved in obtaining such magnification, four sets of special diaphragms are used in pairs. Their movement is transmitted to the main lever through flexing strips, thus avoiding the use of pivots, and then by a special form of link to the pen arm, the record being obtained on the ordinary clock-driven drum. The charts are five inches wide, since this does not provide for the possible range of pressure in one place, it is necessary to reset the pen when the latter reaches the top or bottom of the chart, there is a spring-controlled thumb-screw for carrying this out. A failure to secure the necessary freedom of movement for recording minute variations of pressure would be evident from the appearance of 'flats' or 'steps' in the trace. Of these there are no examples on the specimen chart, which incidentally, thanks partly to the quiet anticyclonic conditions prevailing during the week in question, shows the diurnal variations of atmospheric pressure very clearly. One obvious use of the instrument is for obtaining the changes of pressure at the ground for correcting the indications of height given by an altimeter. The claim that it will measure changes of the order of two hundredths of an inch would appear to be an understatement of the sensitivity if the specimen record is a typical one. The price, with ink, pen, and 100 charts, is £40.

**Origin of Vitamin C**—Three Scandinavian workers, Ottar Rygh, Aagot Rygh, and Per Laland, have obtained what appears to be conclusive evidence that

narcotine, one of the less toxic alkaloids present in opium, is a, if not the, precursor of the antiscorbutic vitamin C. In the first issue of the *Zeitschrift für physiologische Chemie* for 1932, these authors describe how they found the alkaloid in various unripe fruits and vegetables, but failed to detect its presence in the ripened materials. From 200 unripe oranges they prepared 600 mgm of the alkaloid, and by extracting the concentrate, consisting of oil and crystals, from 15,000 oranges at various stages of ripeness, they were able to trace the gradual increase in antiscorbutic power as ripening proceeded. Pure, commercial narcotine was not antiscorbutic, but irradiation from a quartz mercury vapour lamp activated it to some extent without appreciably altering its physical properties. Guinea-pigs were fed on dietaries containing narcotine and irradiated narcotine, both groups died about the same time, but the former group developed strong signs of scurvy before dying and the latter none. Narcotine was found in unripe tomatoes (20 mgm in 20 kgm), white cabbage (40 mgm in 100 kgm), and in potatoes (12 mgm in 20 kgm), qualitative indications of the presence of narcotine were found in milk, but none in red bilberries. Of various derivatives of narcotine, the ortho-dihydroxy derivative—methylornarcotine—was found to be particularly antiscorbutic. In presence of germinating seeds, known to produce vitamin C, narcotine became active, it disappeared and gave rise to phenols.

**Electric Moment and Temperature**—Experiments on dipole moments of substances have shown that, in many cases, these are independent of temperature. One or two cases in which a variation has been reported have been explained on the basis of association, but they are somewhat doubtful. Smyth, Dornie, and Wilson have now discussed the effect of intramolecular rotation upon the moment of a molecule of the type of ethylene chloride, both on the classical and quantum theories (*J Amer Chem Soc*, Dec 1931). The quantum calculation shows that, at room temperature, the great majority of the molecules are in low energy levels, where the dipoles oppose one another to a considerable extent, giving a low mean moment. With rising temperature there is an increased oscillation, but the seventy-fifth level is still short of complete rotation. In the experimental part of the paper it is shown that the polarisation of ethylene chloride increases with rising temperature in dilute solutions but decreases in concentrated solutions, the change of polarisation with concentration being surprisingly small. The moments of ethylene chlorobromide and diethyl succinate also vary with temperature. Ethylene chloride and bromide, ethylene chlorobromide and diethyl succinate show different moments in heptane and benzene solutions, so that the moment of a molecule containing two or more dipoles, the axes of which may alter their positions relative to one another, may be affected both by temperature and environment.

**Theory of the Glass Electrode**—Dole has described (*J Amer Chem Soc*, Dec 1931) some experiments on the glass electrode and given a full critical account of the theories proposed to explain the behaviour of this electrode. The electrode behaves differently in three well-defined pH regions. Between pH 1 and pH 9 it gives potentials which vary with the hydrogen ion activity in the same way as a hydrogen electrode. Above pH 8 or 9 and below pH 0 or 1 it behaves anomalously. There are three main groups of theories of its behaviour, namely, the phase boundary theory, the ion exchange or adsorption theory, and the membrane or diffusion potential theory. There are some

difficulties in all these theories in their present state, the first being inconsistent with facts and the second containing improbable or unverified assumptions. A new equation for the electrode is developed which is shown to agree with the data up to  $pH$  12. A similar equation may be derived, for univalent salts, from the Henderson and Planck liquid junction equations if the relative mobility of the positive ions is assumed to be a function of  $pH$ . It is assumed that the electric double layer at the glass-aqueous solution interface determines the selective mobility of the ions across the boundary.

**Anhydrous and Hydrated Manganese Sulphate**—In a paper presented recently to the Czech Academy of Science (*Collection of Czechoslovak Chemical Communications*, 1931, pp 517-35) Prof. H. Křepelka and Dr. B. Rejha describe the results of an exhaustive research upon the hydrates of manganese sulphate. No less than fourteen different compounds have been mentioned in the literature, but in this investigation the authors have established the existence of only six of these, namely, the anhydrous salt, two forms of the monohydrate, and salts with four, five, and seven molecules of water of crystallisation. Those compounds previously described as possessing a half, two, three, and six molecules of water of crystallisation are said definitely not to exist. It is further stated that anhydrous manganese sulphate can be prepared

from any of the hydrated salts by heating first to  $100^\circ C$ , then at  $150^\circ$ , and finally at about  $550^\circ C$  in an electric furnace and, afterwards, slowly cooling in a desiccator. Much attention was paid in this research to the monohydrate,  $MnSO_4 \cdot H_2O$ , which is readily prepared by heating any of the higher hydrates above  $100^\circ C$  but below  $200^\circ C$ . The authors found that it was unnecessary to specify definitely any exact temperature between these limits. Again, on exposure to air the higher hydrates effloresce, leaving the monohydrate, which, it is concluded, must have the same pressure of aqueous vapour as the atmosphere. The anhydrous salt also absorbed moisture from the air, forming the monohydrate. Prepared in this manner the salt is not polymerised, but when formed by dehydration at temperatures above  $100^\circ C$ , its molecular weight was double that of the single salt. The essential condition for the separation from solution of crystals containing four molecules of water of crystallisation is that the temperature should be between the limits  $26^\circ$  and  $45^\circ C$ . Above and below these points mixed crystals make their appearance, and this may have misled earlier investigators into the error of reporting the isolation of non-existent hydrates. The salt,  $MnSO_4 \cdot 5H_2O$ , separates most conveniently from aqueous solution between  $9^\circ$  and  $26^\circ C$ . Below  $9^\circ C$  ordinary manganese sulphate with seven molecules of water of crystallisation is deposited.

### Astronomical Topics

**Sunspot Activity during 1931**—In the annual report of the Council to the Royal Astronomical Society, a summary is included of the sunspot activity for 1931. The average daily area of sunspots measured at Greenwich was approximately 260 millionths of the sun's hemisphere. This value for 1931 is half that for 1930, and the average daily number of spots showed a decrease in about the same ratio. On about forty days during 1931 no spots were seen on the sun's disc. Large groups of spots were, however, by no means entirely absent, and the following dates are the times of central meridian passage of groups of spots of 500 millionths or larger, that is, of the order of size at which a spot is visible near the centre of the disc without telescopic aid: Jan 12.5, Feb 20.6, Feb 20.7, March 15.4, May 20.5, Nov 26.9. The largest of these groups, with central meridian passage on Feb 20.7 and in latitude  $6^\circ$  north, had a maximum area of nearly 1900 millionths. A note on this group was given in *NATURE*, 127, 321, 1931.

Thirteen spots, including three of the above, were observed spectroscopically to be more than usually active. This activity often took the form of brilliant, short-lived eruptions of hydrogen ( $H\alpha$ ), which in several cases were accompanied by dark hydrogen markings moving with high velocity of the order of 50 km/sec. Terrestrial magnetic activity was distinctly less than in 1930, there being seven disturbances of storm range registered at the Greenwich magnetic station as compared with twenty-three in the previous year.

The relation of the sun's activity during 1931 to the present eleven-year sunspot cycle is shown by the following values of the mean daily area of sunspots, corrected for foreshortening and expressed in millionths of the sun's hemisphere:

| Year | Area | Year | Area |
|------|------|------|------|
| 1923 | 55   | 1928 | 1390 |
| 1924 | 276  | 1929 | 1242 |
| 1925 | 830  | 1930 | 516  |
| 1926 | 1262 | 1931 | 260  |
| 1927 | 1058 |      |      |

**Two Very Distant Spiral Nebulae**—Science Service Bulletin for Jan. 14 reports a further advance in the study of the radial motion of the distant spirals which has been in progress at Mt. Wilson for some time. Dr. Edwin P. Hubble discovered a cluster of very faint spirals in Gemini, Mr. Milton L. Humason has investigated their radial velocity, and finds a recession of 15,000 miles per second, which is much the highest value yet found. It is generally agreed that the shift of the spectral lines to the red, which is observed in the spectra of these nebulae, is a good measure of their distance from us, whether it arises from actual recession or from some other cause. The distance deduced in the present case is 135 million light-years, which is approaching close to the 150 million light-years estimated some years ago to be the limit of the region of space within the reach of the 100-inch reflector at Mt. Wilson. It is anticipated that the contemplated 200-inch mirror will greatly extend the limit.

**Mass of Eros**—Prof. W. H. Pickering points out in *Popular Astronomy* for January that if we accept the duplicity of Eros, which has long been suspected, and was strongly supported by the observations of Messrs. van den Bos and Finsen at Johannesburg a year ago and those of Mr. L. Campbell at the same time, we have the means of deducing the mass with considerable accuracy. The distance between the centres of the two bodies is taken as 17 miles. Their period of revolution is known with great accuracy from the light-variation, it is  $5^h 16^m 12.94^s$ , the mass comes out  $1/177,000,000$  of the earth, or about  $1/2,000,000$  of the moon. Taking the diameter of each component as 8 miles, Prof. Pickering finds the density of each component to be 15.6 times that of water—an improbably high figure. It would be reduced to the density of iron if the diameters were 10 miles. The latter value for the diameters gives the albedo as 0.30, or two-thirds that of the earth—not an impossible value.



## The University of Edinburgh

## EXTENSION OF DEPARTMENTS OF GEOLOGY AND ENGINEERING

## GRANT INSTITUTE OF GEOLOGY

THE accommodation provided for the teaching of geology at the University of Edinburgh has been very inadequate ever since the establishment of the chair in 1871, with Archibald Geikie as the first professor. Owing to the great influx of students at the close of the War, the Department became so congested that it was impossible to carry on the practical classes at the Old University Building.

dors are returned down the centre of the wings, terminating in a lecture hall, 42 ft. 6 in. by 31 ft. (to seat 175), in the east wing, and in a room for the collections of mineralogy and petrology in the west wing. Leading directly from the corridor on the ground floor are the laboratories for economic geology, mineralogy, and elementary and honours petrology, with rooms for the lecturers and for research—and all having windows looking north. On the south side of the corridor are the chemical laboratory, with

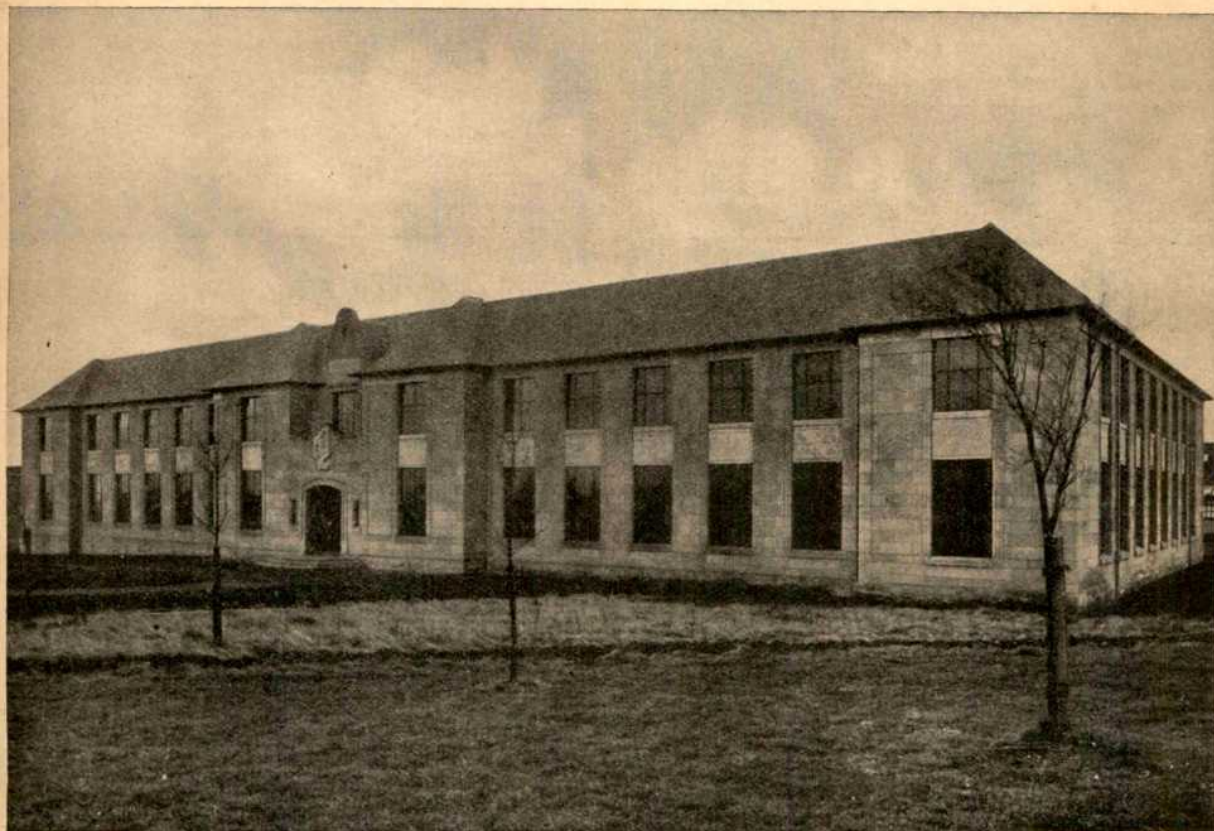


FIG. 1.—The Grant Institute of Geology, Edinburgh.

Temporary quarters were provided in wooden huts which served the purpose for a time, but by 1929 these were falling into a state of disrepair. At this juncture, Sir Alexander Grant came to the aid of the University, and gave £50,000 for the erection of a new geological building. Sketch plans were prepared by Prof. Jehu and his staff and placed in the hands of the well-known architects, Sir Robert Lorimer and Mr. John F. Matthew.

The new building was completed this year and was formally opened by the Prime Minister on Jan. 28. It forms a part of the King's Buildings inaugurated by King George V., and is situated midway between the Chemistry and Zoology Departments, with a frontage of 213 ft. The building has two wings, giving a total depth from north to south of 108 ft.

The main entrance, facing north and centrally placed, leads to the hall and staircase, with corridors branching off right and left the whole length of the building, and lit by windows at the ends. The corri-

balance room, and photographic and optical dark rooms, a workroom, and cloakrooms for men students. The accommodation in the wings includes a large blow-pipe laboratory with students' and departmental rock-cutting rooms, research, tutorial, and preparation rooms.

On the first floor facing north are the professor's room and laboratory, laboratories for elementary and advanced palaeontology, a room for the lecturer in palaeontology, and a group of research rooms. On the south side of the corridor are the assistant's room, the office and typist's room, cloakroom for women students, and storage accommodation. In the west wing lie the room for stratigraphy and map drawing, a small lecture room, with the library occupying the south end. The library is perhaps the best-equipped departmental library in the University, due largely to the gift of books and papers by the two Geikies. The east wing is occupied by the elementary palaeontology laboratory, and a research room, and terminates



in a large museum. The museum contains mineral collections given by Mr. Brown of Lanfine; the collection of minerals, rocks, and fossils left by Sir Charles Lyell and presented by the late Lady Lyell of Kinnordy; and the collection of the late Dr. James Currie, so generously given to the University by Mrs. Currie and family.

In addition to the main staircase, a service stair has been provided in each wing, and an electric lift. Both the library and the museum have storage rooms adjoining, and in the attic a large space has been reserved for the accommodation of surplus collections.

enlarged fossil shell forms the setting for the figure. This feature is the work of Alexander Carrick.

The University is now provided with an excellently planned and well-lit building worthy of the city of Edinburgh.

#### SANDERSON ENGINEERING LABORATORIES

The new engineering building also forms part of King's Buildings. It fronts Mayfield Road and lies south of the new zoology buildings. In plan the front extends to a length of 200 ft. with a depth of 144 ft. from east to west, the water tower and cement and

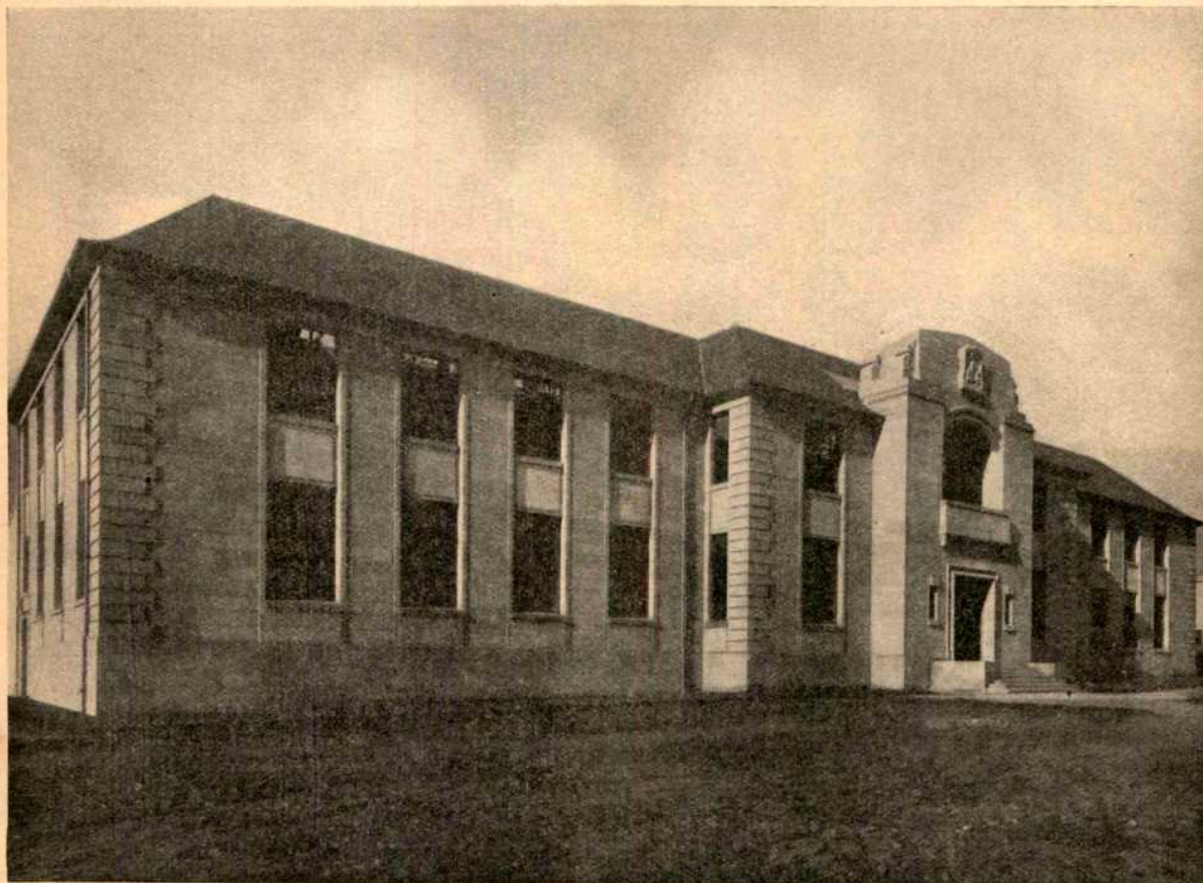


FIG. 2.—The Sanderson Engineering Laboratories, Edinburgh.

At the east end of the building, owing to the level of the ground, an excellent basement was made possible, and here are situated the heating chamber, switch room, additional storerooms, and access to the lift.

The masonry of the new building is of sandstone from Blaxter Quarry in Northumberland. The floors are constructed in reinforced concrete, and the roofs are covered with Ballachulish slates. The window frames are galvanised steel. The heating is by low pressure steam supplied from the central boiler installation, which supplies the heating for all the buildings on this site. The paving in the entrance hall and the staircase is synthetic stone. The floors and dadoes in the corridors and cloakrooms are finished with terrazzo, otherwise the flooring throughout is pitch pine.

Appropriate to the purpose of the building, the figure carved in stone over the main entrance represents early man seated on a rock, his left arm supporting a slab with a fossil shell embedded in it; another

concrete testing rooms projecting beyond the west side. The two-storied front part of the building accounts for practically one half of the total area. On the ground floor are a lecture hall, with seating accommodation for 216 students, and three smaller classrooms, lavatories, and various storerooms. The front upper floor is devoted to the drawing office—a spacious room 155 ft. long and 28 ft. wide—and the departmental library, while on the west side of the upper corridor are the various staff rooms and rooms for photographic work and research.

A corridor on the ground floor, 12 ft. wide, extending the whole length of the building, gives access from the front of the building to the four laboratories, workshop, and boilerhouse; these are all one story in height, well lit by roof lights in the steel-constructed roof. Wide sliding doors at the rear of the laboratories give access to the roadway surrounding the building, and this facilitates the reception of new machinery or plant for testing purposes.



The most southerly of the laboratories, devoted to experimental work on the testing of materials, has a floor area of about 3000 square feet, and is equipped with some twenty testing-machines, varying in power from 1 ton to 100 tons. The plant is arranged both for ordinary teaching work and for research.

Adjoining this are the heat engines laboratory, divided into two bays, and the boilerhouse—the floor space is about 5000 sq. ft.; one bay is devoted to internal combustion engines and the other to steam plant. The plant in the internal combustion bay includes types of gas engines and heavy and light oil engines of the most recent make, and in the

hydraulics laboratory, the floor of which is laid out on two levels. Most of the experimental apparatus is on the upper level, and all the discharge from this apparatus is led by drainage channels to large measuring tanks beneath the floor at the lower end of the laboratory. An open concrete channel, 30 ft. long and 3 ft. wide, runs the whole length of the upper level and discharges over a weir into the measuring tanks, which have a capacity of 10,000 gallons. The tanks have been built in reinforced concrete. For work requiring a steady head, a storage tank of 6500 gallons capacity has been built in, at the top of the water tower, giving a head of 70 ft. Every

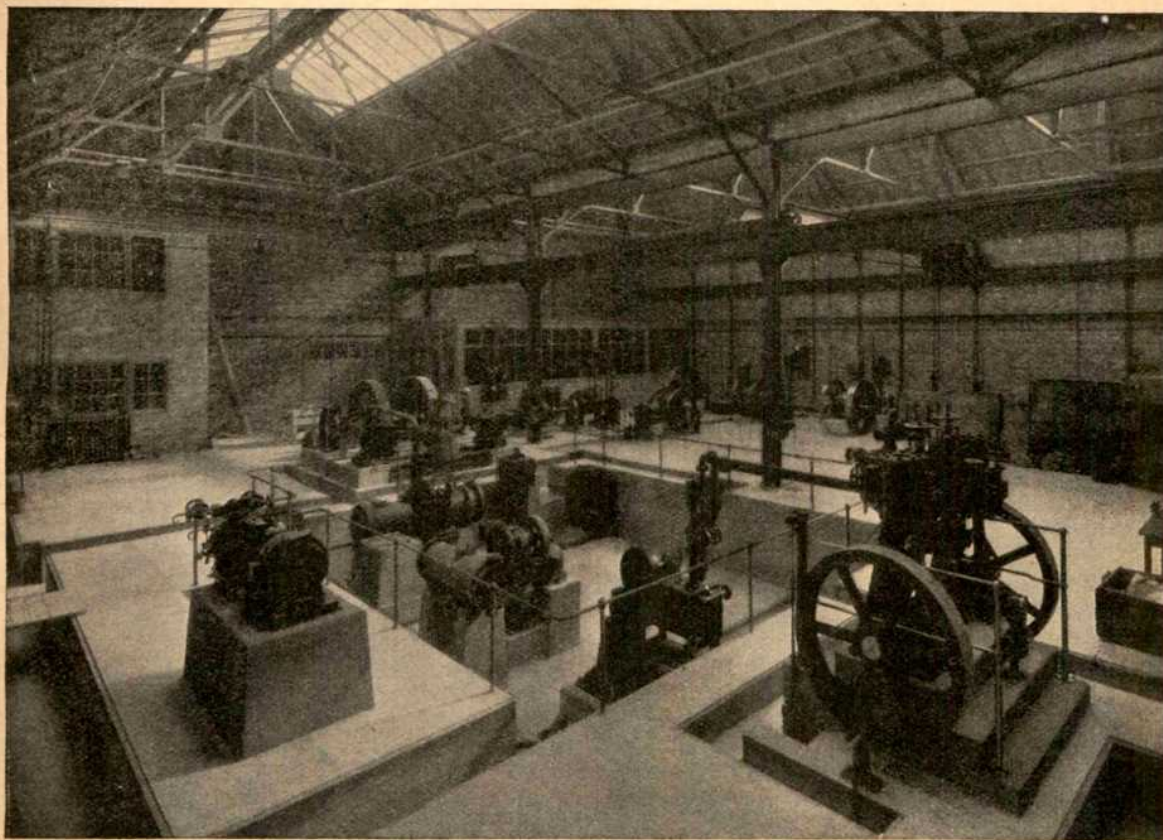


FIG. 3.—Heat Engines Laboratory in the Sanderson Laboratories.

steam bay both reciprocating engines and turbines have been installed. All the necessary condenser plant for these is concentrated in a pit some four feet below the laboratory floor level. All these units are fitted with measuring appliances to enable complete thermal efficiency tests to be made. The experimental steam boiler, of the latest Yarrow type, can supply ample steam at a pressure of 250 lb. either saturated or superheated, and the boiler is equipped with all the necessary measuring appliances for complete thermal tests under all working conditions.

The next bay to the north is occupied by the

piece of apparatus in this laboratory is provided with a measuring gauge, either of the Venturi type or of the orifice type, thus making it a self-contained unit, so that many experiments can be carried on simultaneously.

Beyond the hydraulics laboratory, in the last bay, a mechanics laboratory has been fitted up for experimental work on applied mechanics.

The cost of the buildings was met by a bequest of about £50,000 by the late Mr. James Sanderson, senior partner in the firm of Messrs. R. and A. Sanderson and Co., one of the oldest established firms in the Scottish tweed trade in Galashiels.

### Mental Deficiency

**D**URING the centenary meeting of the British Association held in London in September, several papers on different aspects of mental deficiency were read before Section J (Psychology). Dr. E. O. Lewis spoke on the social aspect of the subject, Prof. F. A. E. Crew on its genetic background, Dr.

F. C. Shrubbsall on the incidence of different types, and Dr. R. G. Gordon on some psychological experiments he made on mental defectives at Stoke Park Colony in collaboration with Dr. E. Norman.

Dr. Lewis set forth some fundamental issues involved in the social problem. Public interest has



been shown in mental deficiency and especially in the discussion of remedial measures. Some of these measures bear the hall-mark of empiricism; they show no clear conception of the nature of mental deficiency and would, if adopted, probably do much harm without achieving much good. Progress in arriving at a solution of the social problem presented by mental deficiency is considerably hampered by failure to appreciate the complexity and variety of clinical conditions to which the generic term 'mental deficiency' is applied. There are varying degrees and varying types, so that it is advisable to speak of mental deficiencies rather than mental deficiency. No single remedial measure is applicable to all cases.

Mental deficiency is a variation from the normal, and there are two types of such variation, normal and abnormal: the former is called by Dr. Lewis *sub-cultural*, the latter *pathological*. The pathological group comprises those whose condition is due to a definite organic lesion or abnormality; in the sub-cultural group there is no such alien factor, the deficiency is only an extreme variety of normal variation and of mental endowment; there is no definite cleavage between this group and the mass of normal persons. The higher grades of sub-cultural deficiency merge gradually into the lower grades of dullness or of temperamental instability; there is a close biological kinship between them and the mass of normal persons, a kinship which can not be attributed to the pathological defective.

This classification, Dr. Lewis considers, helps one to understand the social problem. Most of the pathological cases are lower grade defectives, idiots or imbeciles, whereas most of the sub-cultural cases are feeble-minded, a milder form of mental defect. Most defectives belong to the sub-cultural group: the feeble-minded are approximately three times as numerous as the lower grade defectives. The pathological cases are evenly distributed among all sections of the community, whereas the sub-cultural type is concentrated to a large extent in the lower section and is often associated with various chronic social evils, such as chronic pauperism, slumdom, and its concomitants. Heredity is an important factor in the production of the sub-cultural group, though, undoubtedly, pathological defects also are inherited in some cases. When several defectives appear in one family, they are almost invariably of the sub-cultural type, and most of the members of the family who are not mentally defective are of subnormal intelligence.

It is the sub-cultural group which is the social problem. The fact that it is a normal variant makes it an index of the mental state of the whole group—it is a form of general mental debility. Remedies should not be surgical, but preventive: the solution of the social problem of sub-cultural mental deficiency lies in increasing the mental vitality of the whole community.

Prof. Crew, speaking on the genetic background of mental defect, said the human subject is the least convenient material for genetical study, that almost all that is known of hereditary characters refers to details of structure which are easily recognised and readily measured, and, save by grossly unfavourable physical conditions, are apparently uninfluenced by environmental factors, but that there are many heritable characters the actual expression of which is conditioned by environmental agencies. There are three kinds of mental deficiency: (1) the type in which the character is the direct expression of genetic factors unaffected in their action by environmental forces; (2) the type in which the character for its expression requires the interaction of genetic con-

stitution and environmental factors; and (3) the type which is a non-inherited acquisition. Differential diagnosis is difficult: the real difficulty is to decide whether genetic or environmental factors (or both) are operating in any given case. The difference between normality and abnormality may be magnified by environmental agencies. So long as the demonstrable significance of those agencies is disregarded and attempts are made to find a single constant basis for a character which can be the end-result of so many different developmental happenings, there can be no hope of assessing the rôles of whatever genetic factors may enter into the determination of mental deficiency.

Since defect of mind is no more of a biological unity than is defect of body, mental deficiency may be genetically many different things, in some instances an autosomal recessive, in others an autosomal dominant, sex-linked, or multiple factor character, or even a step-allelomorph. The evidence points in that direction, and such a view is more helpful in an analysis of the etiology of the condition than that which insists that there is a constant genetic origin for it. That genetic factors play a prominent part in the etiology of mental deficiency is certain, but as to their nature or number there is no precise knowledge. What is needed is investigation and careful critical analysis. Only when such research has been carried out can policies relating to the control of mental deficiency through controlled breeding be framed which will command the unqualified endorsement of the geneticist.

Dr. R. G. Gordon described the results of a repetition on two hundred mental defectives of experiments made by Sir Henry Head on aphasics. He found that while language as a whole is difficult for defectives, pure language manipulation is easier than spatial orientation and control, and that this conclusion is borne out by other experiments with puzzle-boxes in which the behaviour of his subjects showed definite similarity to that obtained by analogous experiments with animals.

### University and Educational Intelligence

CAMBRIDGE.—The Gordon Wigan prize for chemistry for 1931 has been awarded to A. H. Hughes (Trinity Hall) for a thesis entitled "The Constitution of Surface Films of Organic Molecules".

The Cambridge University Natural Science Club will hold a dinner on Saturday, March 5, to celebrate the 1300th meeting of the Club. Past members wishing to attend should communicate with the secretary, D. W. I. Piggott, Gonville and Caius College, Cambridge.

GLASGOW.—The Frazer lecture in anthropology will be delivered on March 4, by Sir Arthur Keith.

THE annual meeting of the Association of Technical Institutions will be held in the Leathersellers' Hall, St. Helen's Place, London, E.C., on Feb. 26-27, under the presidency of Sir John Dewrance. The following papers will be read: "Technical Education in Canada", by Prof. R. W. Angus; "Technical Education in the Bakery Trade", by Mr. W. H. Quinn; and "Teaching of Modern Languages in Technical Colleges", by Mr. P. G. Wilson. Mr. J. Cameron Smail, principal of the Heriot-Watt College, Edinburgh, will give an address on the report on "Policy in Technical Education", and Sir Francis Goodenough on the report on "Education for Salesmanship". A demonstration of the use of the gramophone in



teaching modern languages will be given by Mr W. H. Kerridge. The secretary of the Association is Dr. H. Schofield, Loughborough College, Loughborough, Leicestershire.

THE examination for county minor scholarships of 15,485 children of 10-12 years of age in the West Riding of Yorkshire last February forms the subject of an interesting report issued by the County Education Committee. The task of organising the assignment of marks to so large a number of examinees with the nearest possible approach to uniformity presents formidable difficulties, and the report sets out in detail how these difficulties were met. A decentralised system of marking was adopted in 1927 with the object of associating in the conduct of the examination the whole body of teachers in the area. By selecting the assistant examiners from a panel nominated by local committees, by limiting their number to about fifty, by assigning to them scripts in their favourite subjects, and by facilitating conference and consultation, this system has gradually been perfected and is now working satisfactorily. For the written test, papers were set in English and in arithmetic. These are reproduced in the report, with comments by the chief examiners. Taken with the statistics of results classified according to percentages of marks obtained, the whole report gives a fairly definite measurement of the intelligence of the children of the county.

### Calendar of Geographical Exploration

Feb. 22, 1878 —The Essequibo and its Tributaries

Sir Everard im Thurn started from Aretaka, south of Bartica, on his first expedition up the Essequibo River. Thence he went by canoe to Pirara, and from that point crossed the savannah to the Takootoo River, down which he travelled to its junction with the Branco. Later in the same year he visited the Kaieteur falls on the Potaro River, which here leaps 750 feet, the falls had been first visited in 1871 by C. Barrington Brown. In further visits to the region he explored other rivers, notably the Cuyuni and the Mazaruni. But his most important work was on the ethnological side, his studies of the customs of the Indians of British Guiana have become a classic.

Feb. 23, 1540.—The Coronado Expedition

F. V. de Coronado left Compostela with an army to conquer the Seven Cities of Cibola, now identified as probably the Zuñi Pueblos of New Mexico. Coronado went to Mexico in 1535 and became governor of New Galicia in 1539. In that year he heard rumours of the fabled wealth of Cibola and determined to conquer it. In this he succeeded, but he found no wealth. He moved westwards to the Rio Grande and sent out exploring parties, one of which found the records of Alarcon. The latter in 1540 ascended the Gulf of California and explored the Colorado River from its mouth. He reported that lower California was a peninsula. Another party under Cardenas discovered the Grand Cañon of the Colorado, which baffled their efforts to cross it. Coronado himself proceeded to Quivira, reported to be an El Dorado, which seems to have been in the region where the Arkansas and Kansas Rivers approach one another. Coronado and the tattered remnants of his army reached Mexico in 1542, having completely failed to find gold or silver. But from a geographical point of view his march was of first-class importance. It formed the basis of the cartography of the hitherto unknown interior of the northern continent. It gained the first information about the sedentary Pueblo tribes of the south-west

of the United States and about the hunting tribes of Indians dependent upon the bison, an animal never before seen by the Spaniards, who called it a cow. In addition, the Grand Cañon had been discovered and the lower Colorado explored.

Feb. 23, 1770 —The Great Slave Lake

Samuel Hearne, an agent of the Hudson Bay Company, started on a journey the objects of which were to verify a rumour of the existence of copper ore and to find out whether there was a passage westward from Hudson Bay. He reached the northern shore of Dubawnt Lake, but there broke his quadrant and therefore returned. He had covered some new ground, but had failed in the main object of his journey. In December of the same year he started again, reached the Coppermine River, and followed it to its mouth, thus for the first time reaching the Arctic Ocean in this region. On his return journey he followed a different route and discovered the Great Slave Lake, which he crossed. He himself called the lake Athapuscow, and it was by some thought to be Athabasca, but his route indicates that this was a mistaken identification. His voyage settled the question of the existence of a north-west passage from Hudson Bay.

Feb. 26, 1807 —Pike's Peak

Z. N. Pike arrived at the Rio Grande del Norte, in the region where Alamosa, Col., now stands, and was taken prisoner by the Spanish authorities. Pike had set out in 1806 to lead an expedition which was to explore the country west and south-west of St. Louis to the headwaters of the Arkansas and Red rivers. He ascended the Arkansas through the Royal Gorge and sighted the mountain which now bears his name. He mistook the Rio Grande del Norte for the Red River. The Spanish sent him to Santa Fé and then to Chihuahua, whence he was deported, returning home through Texas. His account of his experiences made available for the first time a fairly accurate knowledge of New Mexico, Texas, and northern Mexico.

### Societies and Academies

#### LONDON

Royal Society, Feb. 11 —J. Chadwick and J. E. R. Constable. Artificial disintegration by  $\alpha$ -particles (2) Fluorine and aluminium. The protons liberated from fluorine and from aluminium when bombarded by  $\alpha$ -particles from polonium have been examined. In each case they can be resolved into definite groups which occur in pairs. The results are explained on the assumption that the  $\alpha$ -particles can enter the nucleus through certain resonance levels. To explain the fluorine disintegration it is necessary to suppose that there are two (possibly three) levels, while for aluminium four levels must be assumed. — A. J. Bradley and A. H. Jay. The formation of superlattices in alloys of iron and aluminium. Alloy structures of iron and aluminium in the range Fe-FeAl are primarily based on a simple body-centred cubic lattice like that of  $\alpha$ -iron, but a detailed examination of the annealed and quenched states gave widely-differing results. Alloys quenched from 600° C. and above showed a random distribution of atoms up to 25 atomic per cent aluminium. Between 25-26 per cent and 50 per cent aluminium, cube centres differ in composition from cube corners. Annealed alloys with less than 18 atomic per cent aluminium have a random distribution, and at 40-50 per cent aluminium they have the FeAl type of structure exactly like the quenched alloys in this range. At intermediate compositions a new type of structure appears, which

is of the type  $\text{Fe}_3\text{Al}$ . In the latter the aluminum atoms lie on a face-centred cubic lattice with dimensions twice as great as those of the small body-centred cube—E B Moullin. A method of measuring the effective resistance of a condenser and of a long, straight wire. The method consists in using similar coils with wires of different specific resistance, and in plotting the measured resistance of the whole circuit against the calculated resistance of the coil. The result is a straight line which does not pass through the origin, thus showing that there is a component of resistance which does not depend on the conductivity of the material: the intercept on the resistance axis shows the effective resistance of the condenser at the frequency in use. The coils were long, narrow rectangles, and for such the skin effect formula for a long, straight wire is applicable without modification.

## DUBLIN

Royal Dublin Society, Dec 15—J Lyons and W. Finlay. The accuracy of fat determinations in butter-milk, and the effect of the presence of lecithin. The quantity of fat in buttermilk, as determined by certain methods, is affected by the lecithin content. The Gerber test is compared with the Rose-Gottheb and the Minnesota tests, and the results show that the Gerber, like the Rose-Gottheb, is affected by the lecithin present, while the Minnesota is not influenced by it.—J. H. J. Poole. Some measurements of the rate of flow of heat from water at nearly  $0^\circ\text{C}$  to a submerged horizontal ice surface. The problem of the transference of heat from a liquid to its own solid by convection currents is of some geological interest. This paper describes certain measurements made for water and ice. The heat flow obtained was rather larger than had been expected. Unfortunately, however, it is difficult to determine what effect the dimensions of the ice surface would have on the results.

## PARIS

Academy of Sciences, Jan 4—L Blaringhem. The fertility of the white lily, *Lilium candidum*. Details of a method of obtaining good seeds.—Gabriel Bertrand and P de Berredo Carneiro. The existence and distribution of caffeine and of theobromine in the organs of the guarana. Both caffeine and theobromine were found, but very unequally distributed in the various organs.—Emm de Margerie. Third and last report on the publication of the geological works of Marcel Bertrand.—Lucien Daniel. *Procydonia Claraci*.—Bertrand Gambier. The transformation of a simply infinite family of geodesics and of the family of conjugated curves.—Paul Delens. Varieties with affine connexion. The generalisation of Riccati's equation.—Gaston Julia. A decomposition of multiply connex areas.—Paul Montel. Harmonic functions admitting exceptional values.—René de Possel. Some problems of conformal representation.—Arnaud Denjoy. Some points of the theory of functions.—Paul Le Rolland. On the possibility of realising an arrangement for the measurement of time, insensible to the accelerations of its support.—F. J. Bourrières. The free oscillations of the extremities of elastic tubes traversed by a uniform current of fluid.—H Journaud. Vortices in bands.—D. Rosenthal. The increase of resistance to repeated impacts of parts joined by welding.—Pierre Dive. The existence of a permanent regime of rotation in a fluid star with rings.—Henri Mineur and Pierre Guintini. The analytical study of the movements of the helium stars.—Georges Bouligand. A point concerning the technique of vibrations.—R. Ferrier. The slip of a periodic electrical influx along a cylinder axis.—A. Guillet. Contribution to the construction and use of

an apparatus for the measurement of small deformations.—Th V. Ionescu and C Mihul. Ionised gases in the magnetic field. Proof of the existence of the spinning electron. An experimental study of the effect of a magnetic field, parallel to the armatures of the ionised gas condenser, on the variation of the capacity and conductivity of this condenser for wavelengths between 2.34 metres and 19 metres. The experimental curves coincide well with the calculated curves.—J J. Trillat and Th v Hirsch. Researches on the diffraction of electrons by single crystals of gold and platinum.—C. Cheneveau and C Courty. The direct measurement of the magnetic susceptibilities of liquids by the Curie-Cheneveau magnetic balance. With a calibrated tube of the ordinary pattern, it is possible to measure directly the magnetic susceptibility of a liquid with the Curie-Cheneveau magnetic balance without weighings and without determining the density of the liquid.—P Lambert and J Lecomte. The infra-red absorption spectra of the benzene hydrocarbons.—J. Cabannes and A Rousset. The rules of polarisation of the Raman lines in liquids. Theoretical statements and experimental verifications.—René Audubert. The influence of electrolytes on photovoltaic phenomena. Admitting the photolysis of water, suggested as a working hypothesis by the author in a previous paper, a rational explanation is afforded of the influence of electrolytes on the photovoltaic effects.—A Grumbach and F. Taboury. The law of equidistances in photovoltaic batteries.—P. Fourmarier. The study of the lag in photoelectric gas cells. In the working of gas cells the ionisation by the positive ions cannot be neglected: this ionisation is probably the main cause of the lag.—K Boratynski and A Nowakowski. Researches by means of X-rays on the modifications of phosphoric anhydride. From the X-ray photographs it is concluded that commercial phosphorus pentoxide consists mainly of a crystalline form. During sublimation there is a partial disappearance of the crystalline structure and this is attributed to a process of polymerisation.—Georges Denigès. The direct realisation of the permanganate reaction of manganese even in solutions containing as much chloride as sea water. The usual methods for converting manganese salts into permanganate (lead peroxide, sodium bismuthate) fail in the presence of chlorides. Oxidation with hypochlorite, in the presence of copper sulphate as catalyst, can be carried out in presence of chlorides.—G Champetier and U. V Thuau. The dehydration of cupric hydroxide. X-ray diagrams of cupric hydroxide, taken at various stages of dehydration, show that at no stage are compounds other than copper oxide and copper hydroxide present.—A. Perret and R Perrot. Lithium cyanamide. Study of the reaction between lithium and cyanogen.—Mme Ramart-Lucas and J Hoch. The absorption in the ultraviolet and chemical reactivity of certain classes of organic compounds.—Charles Dufraisse and Nicolas Drisch. Researches on the dissociable organic oxides. Substances presenting reversible oxidisability in aqueous solution. Dibromorubrene has been converted into the corresponding dicarboxylic acid by the Grignard reaction. The solutions of the free acid and its salts present all the peculiarities characterising solutions of bodies belonging to the rubrene group, including the decoloration by air in the presence of light, and the formation of a dissociable oxide.—L. Palfray, S Sabetay, and Mlle. Denise Sontag. The action of potash on some aryl-fatty mercaptans. The primary mercaptans, in the  $\beta$  position with respect to the phenyl residue, lose sulphuretted hydrogen much more easily to potash than the other aryl-fatty mercaptans.—Charpentier and

Bocquet Crystallised sodium  $\alpha$ -glycero-phosphate — R Cornubert and P Robinet Constitution of the combinations known as tetrahydropyronic — Paul Gaubert The crystals produced by the solidification of a fused substance containing colouring matters in solution — Jean Lacoste Observations on the pre-Riffian and southern Riffian nummulitic series — Paul Fallot. The geology of the borders of the provinces of Murcia and of Alicante — P Russo The age of the formations of the Zuma basin, region of Safi (Morocco) — D. Skobeltzyn The angular distribution of the ultra-penetrating rays (cosmic rays) — M. Branas The caryology of the Ampelideae — Joseph Szymanek and Pierre Gavaudan Caryological observations on some species of *Gossypium* — N. Löwenthal. The transformations of orthogenetic order of the external Merbomus glands in some rodents — Paul Remy. The fauna of forest humus. — René Hazard Spar-teine and adrenaline — Mme. J. Goude-Axelos and André Claude. Bulbs with rare gases for the production of ultra-violet radiations. Tubes containing mixtures of neon, xenon, and krypton, excited by high-frequency currents with external electrodes, were studied from the point of view of use in therapeutics and also for use as daylight lamps for colour matching. Variations were made in the proportions of the gases in the tube and in the density of the current — A Paillet The variations in normal bacterial parasitism in *Chaetophorus lyropictus* — Georges Lakhovsky. A new method of filtration and sterilisation permitting the production of a bactericidal water. By the introduction of a certain proportion of silver chloride into the paste used for the preparation of porous porcelain filters, a filter tube is obtained containing finely divided metallic silver. Water filtered through such a tube is sterile.

## WASHINGTON, D C

National Academy of Sciences (*Proc*, Vol 17, No. 10, Oct. 15, 1931). — O. Veblen and J. H. C. Whitehead A set of axioms for differential geometry Describing the class of manifolds of  $n$  dimensions to which the theories at present grouped under differential geometry are applicable — H. Bateman Solutions of a certain partial differential equation — W. J. Trjitzinsky. A synthesis of the theorems of Hadamard and Hurwitz on composition of singularities — Wilder D. Bancroft and J. E. Rutzler, Jr. Reversible coagulation in living tissue (6) Histamine can poison the central nervous system, producing anaesthesia as well as affecting the sympathetic system. Experiments on fresh nerve tissue suggest that the effect is due to reversible coagulation of proteins in the tissue. — (7) The tetanic convulsions caused by strychnine can be checked by sodium rhodanate (peptisation), ephedrine (peptisation), chloroform (agglomeration), curare (motor nerve coagulant) and potassium salts (muscle coagulant). The effects can be explained on Claude Bernard's theory of reversible coagulation of proteins — Arthur Bramley: Radioactive disintegration A theoretical discussion — Francis G. Benedict and Edward L. Fox: Body temperature and heat regulation of large snakes In the python the mouth and rectal temperatures are the same; in the fasting boa rectal temperature is lower than temperature of environment and follows slowly rises and falls with the latter During muscular activity, digestion, and incubation rectal temperature is above that of the environment. Calorimetric measurements showed that in repose the snake gave off no sensible heat, all the heat resulting from metabolism being lost through vaporisation of water By the use of a respiration chamber it was shown that a large snake loses 4.5 gm water per kgm body weight per 24 hours at 30° C

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## Forthcoming Events

## Societies

## FRIDAY, FEBRUARY 19

- INSTITUTION OF CHEMICAL ENGINEERS (Annual Corporate Meeting) (at Hotel Victoria, Northumberland Avenue), at 12 noon — W. A. S. Calder Control of Industry (Presidential Address) — At 2.15 — Dr. Ezer Griffiths. Thermal Insulation
- ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 — Prof. W. E. Le Gros Clark The Structure and Connexions of the Optic Thalamus (2)
- INSTITUTION OF MECHANICAL ENGINEERS (Annual General Meeting), at 5.30 — Report of Council for 1931 — R. W. Bailey and A. M. Roberts Testing of Materials for Service in High Temperature Steam Plant
- ROYAL SOCIETY OF MEDICINE (Radiology Section), at 8.30. — Discussion on X-Ray Treatment of Non-malignant Conditions.
- ROYAL INSTITUTION OF GREAT BRITAIN, at 9 — Prof. C. F. Jenkin The Mechanics of Shifting Sands

## MONDAY, FEBRUARY 22

- ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 — Prof. A. J. E. Cave The Morphological and Functional Anatomy of the Human Cervical Spine

## TUESDAY, FEBRUARY 23

- ROYAL SOCIETY OF ARTS (Dominions and Colonies Meeting), at 4.30 — W. G. Freeman The Empire Fruit Industry (Lecture)
- ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5 — Discussion on Respiratory Movements in Disease
- ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 — Prof. C. Okell The Role of the Haemolytic Streptococci in Infective Disease (Milroy Lectures) (2)
- ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15 — Sir William Bragg Recent Work on Crystal Analysis (3)

## WEDNESDAY, FEBRUARY 24

- ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5 — Discussion on Milk Fever or Hypocalcaemia in Parturient Cows and Similar Conditions in Other Animals and Man.
- ROYAL SOCIETY OF ARTS, at 8 — Dr. Alexander Scott The Romance of Museum Restoration (Lecture)

## THURSDAY, FEBRUARY 25

- ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 — Prof. C. Okell The Role of the Haemolytic Streptococci in Infective Disease (Milroy Lectures) (3)
- ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15 — Prof. J. B. S. Haldane Heredity in Man (2)
- LIVERPOOL BIOLOGICAL SOCIETY (in Department of Zoology, Liverpool University), at 7.30 — Prof. J. H. Orton. Studies on the Relation between Organism and Environment (Presidential Address)
- HUNTERIAN SOCIETY OF LONDON (at Apothecaries' Hall, Water Lane, E.C.), at 9 — Dr. J. B. Christopherson The Etiology of Chronic Bronchitis (Annual Oration).

## FRIDAY, FEBRUARY 26

- ASSOCIATION OF ECONOMIC BIOLOGISTS (Annual General Meeting) (in Botany Lecture Theatre, Imperial College of Science and Technology), at 2.30 — At 3 — Dr. H. Tattersfield, F. R. Cann, and others Discussion on Laboratory Tests of Insecticides — At 5.30 — Presidential Address Temperature and Humidity in Relation to Insect Control
- ROYAL ASTRONOMICAL SOCIETY (Geophysical Meeting), at 4.30 — Dr. S. F. Grace A Method for the Determination of the Tides of a Broad, Deep Sea, with Application to the Gulf of Mexico — Dr. H. Jeffreys (a) On the Stresses in the Earth's Crust required to support Surface Inequalities, (b) The Deformation of the Earth due to Asymmetrical Cooling
- ROYAL INSTITUTION OF GREAT BRITAIN, at 9 — Prof. C. G. Darwin The Uncertainty Principle in Modern Physics.

## SATURDAY, FEBRUARY 27

ROYAL INSTITUTION OF GREAT BRITAIN, at 3—Lord Rutherford of Nelson Discovery and Properties of the Electron (1)

## Public Lectures

## FRIDAY, FEBRUARY 19

UNIVERSITY COLLEGE, at 5 30—Sir E Denison Ross The Unification of Asia under the Mongols  
ROYAL VETERINARY COLLEGE, at 5 30—T M Doyle Diseases of Birds due to Filterable Viruses (1)

## SATURDAY, FEBRUARY 20

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3—Discussion of Members' Topics  
HORNIMAN MUSEUM (Forest Hill), at 3 30—H N Milligan Nature Studies on the Sussex Coast

## MONDAY, FEBRUARY 22

GUY'S HOSPITAL (in Physiological Theatre), at 5—Prof A E Barclay The Use of X-Rays in Physiological Investigations (2) The Anatomy of the Abdominal Viscera  
KING'S COLLEGE, LONDON, at 5 30—Prof T H Robinson The Myth and Ritual of the Old Testament and the Culture Patterns of the Ancient East (5) Hebrew Myths

## TUESDAY, FEBRUARY 23

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5 15—Dr Dorothy Russell Intracranial Tumours (1)

## WEDNESDAY, FEBRUARY 24

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4—Dr W S C Copeman The Control of Industrial Rheumatic Diseases in the Future  
BELFAST MUSEUM AND ART GALLERY, at 8—R G Baskett Menus for Farm Animals

## THURSDAY, FEBRUARY 25

KING'S COLLEGE, LONDON, at 3—C J Gadd Assyrian Dealings with Israel  
UNIVERSITY COLLEGE, at 5 30—Sir J J Thomson Physical Lines of Electric Forces and their Application to the Interpretation of the Electromagnetic Field (2)  
KING'S COLLEGE, LONDON (at 40 Torrington Square, WC1), at 6—S P Turin Economic Conditions in Russia To-day (6) Equality of Incomes

## FRIDAY, FEBRUARY 26

UNIVERSITY COLLEGE, at 5 15—Prof A J Clark The Reaction between Drugs and the Cells (1)—At 5 30—Sir E Denison Ross Persia, 1215–1720  
KING'S COLLEGE, LONDON, at 5 30—The Brazilian Ambassador Brazil and its Development  
ROYAL VETERINARY COLLEGE, at 5 30—T M Doyle Diseases of Birds due to Filterable Viruses (2)

## SATURDAY, FEBRUARY 27

HORNIMAN MUSEUM (Forest Hill), at 3 30—J H Driberg Warrior-Herdsman in East Africa

## Official Publications Received

## BRITISH

- Proceedings of the Linnean Society of London, Session 1931–32 Part 1 Pp 16 (London) 6d  
Journal of the Indian Institute of Science Vol 14A, Part 9 The Reactivity of Dimethyldihydroresorcin Part 1 Condensation with Aromatic Aldehydes By Gopal Chandra Chakravarti, Haripada Chatterjee and Prafulla Chandra Ghosh Pp 141 156 (Bangalore) 1 rupee  
Investigations on the Spike Disease of Sandal 3. Report of Progress made during the Quarter ending 30th September 1931 Contributors: C Dover, H A H G Hicks and A R Brand, J E M Mitchell and S Rangaswami, M Sreenivasaya, Y V Sreenivasa Rao, A V Varadaraja Iyengar Edited by Dr V Subrahmanyam Pp ii+20 (Bangalore Indian Institute of Science)  
Indian Journal of Physics, Vol 6, Part 5, and Proceedings of the Indian Association for the Cultivation of Science, Vol 15, Part 5 Conducted by Sir C V Raman Pp 367 486 (Calcutta) 2 4 rupees, 3s

The Journal of the Botanical Society of South Africa Edited by R H Compton Part 17 Pp 27+5 plates (Kirstenbosch National Botanic Gardens)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1419 (Ae 540—S and C 359) Tests on Model of *Wasp* including Effect of Slipstream By A S Hartshorn, D M Hirst and G F Midwood Pp 15+5 plates 1s net No 1423 (Ae 544—T 3128) Some Features of the Earlier Pterodactyl Design By S B Gates and D M Hirst Pp 8+5 plates 9d net No 1420 (Ae 541—T 3124) Wind Tunnel Data on the Balancing of Controls By F B Bradfield Pp 16+26 plates 1s 3d net (London H M Stationery Office)

The Journal of the National Institute of Agricultural Botany Vol 3, No 1 Pp 131 (Cambridge W Heffer and Sons, Ltd) 2s 6d net

Transactions of the Optical Society Vol 32, 1930–31, No 3 Pp iv+85–128 (London) 10s

Department of Scientific and Industrial Research Building Science Abstracts Vol 4 (New Series), No 12, December Abstracts Nos 2238 2500 Pp 403 532 (London H M Stationery Office) 9d net

Department of Scientific and Industrial Research The Investigation of Atmospheric Pollution Report on Observations in the Year ended 31st March 1931 Seventeenth Report Pp vii+110 (London H M Stationery Office) 5s 6d net

Journal of the Chemical Society January Pp v+339+vi (London Chemical Society)

## FOREIGN

Memorie della Reale Accademia d'Italia Classe di Scienze fisiche, Matematiche e Naturali Vol 2 Biologia N 1 L'Origine e l'evoluzione della partenogenesi attraverso i differenti biotipi di una specie collettiva (*Artemia salina* L.) con speciale riferimento al biotipo diploide partenogenetico di Sète Per Cesare Attoni Pp 57+6 tavole 20 lire N 2. Influenza del glucosio sulla produzione ed azione degli anticorpi emolitici Per Giuseppe Marotta Pp 13 3 lire Chimica N 1 La elettrolisi degli ossalati di cromo Per Arrigo Mazzucchelli Pp 15 2 50 lire N 2 La formazione dell'acetone per scissione catalitica dell'acido acetico. Per Giovanni Malquori Pp 15 2 50 lire N 3 Dimensioni degli atomi a degli ioni monovalenti nei reticoli dei cristalli Per G Natta. Pp 31 5 lire N 4 Studi sull'effetto Raman nei terpeni—Ricerche su alcuni idrocarburi Per G B Bonino e P Cella Pp 51 10 lire N 5. Esperienze di desolfurazione di benzine e oli mediante idrogenazione. Per G Roberti Pp 15 2 50 lire N 6 La determinazione della stabilità delle polveri infumi Per F Grottanelli Pp 17 2 50 lire N 7 Sopra alcune reazioni semplici decorrenti ad alta temperatura e sopra la composizione chimica della atmosfera di alcuni corpi celesti Per Giorgio Piccardi Pp 54 10 lire Matematica N 1 Il problema di Dirichlet per le funzioni biarmoniche Per Francesco Severi Pp 27 5 lire N 2 Due lettere inedite di Girolamo Saccheri Per Amedeo Agostini Pp 20 3 75 lire N 3 Intorno alla teoria delle superficie proiettivamente deformabili e alle equazioni differenziali ad esse collegate. Per Beniamino Segre Pp 143 22 50 lire N 4 I funzionali delle funzioni di due variabili Per Luigi Fantappiè Pp 172 27 lire N 5 Contributi alla teoria delle funzioni biarmoniche Per Francesco Severi Pp 59 10 lire N 6 Elenco di numeri primi fra 10 milioni e 500 milioni estratti da serie quadratiche Per L Poletti Pp 107 18 lire Fisica N 1 Nuovi studi sull'effetto "Hall" particolarmente in campi deboli Per M Cantone e E Bossa Pp 31 5 lire (Roma G Bardi)  
Journal de la Société des Americanistes Nouvelle série, Tome 23 Fasc 1 Pp 272 (Paris)

Ministère de l'Instruction publique et des Beaux-arts Enquêtes et documents relatifs à l'enseignement supérieur, 125 Rapports sur les Observatoires astronomiques de Province et les Observatoires et Instituts de Physique du Globe Année 1929 Pp 107 (Paris)

Journal of the Faculty of Agriculture, Hokkaido Imperial University Vol 30, Part 4 Supplementary Notes on the *Platyrodidae* of Formosa, 3, by Jojo Murayama. Beitrag zur Kenntnis der *Endomychiden* Japans, von Yui Ohta Pp 195 242 (Tokyo Maruzen Co, Ltd)

Smithsonian Miscellaneous Collections Vol 86 Smithsonian Meteorological Tables (based on Guyot's Meteorological and Physical Tables) (Publication 3116) Fifth revised edition Pp lxxvi+282 (Washington D C Smithsonian Institution)

Smithsonian Institution Bureau of American Ethnology Bulletin 103 Source Material for the Social and Ceremonial Life of the Choctaw Indians By John R Swanton Pp vii+252+6 plates (Washington D C Government Printing Office) 60 cents

Proceedings of the United States National Museum Vol 79, Art 26 Four New Species of Trematode Worms of the Subfamily Onchocotylinae By Dr G A MacCallum (No 2892) Pp 8+1 plate (Washington D C Government Printing Office)

U S Department of Agriculture Farmers' Bulletin No 1682 Usefulness of Birds on the Farm By W L McAtee Pp ii+14 5 cents Leaflet No 82 Controlling Small Gulls by Bluegrass Sod By R E Umland Pp ii+4 5 cents (Washington, D C Government Printing Office)

Memors of the University of California Vol 9, No 2 An Introduction to the Study of the Oestrous Cycle in the Dog By Herbert McLean Evans and Harold H Cole Pp vii+65 118+plates 12 18 2 50 dollars Vol 9, No 3 Ovogenesis and the Normal Follicular Cycle in Adult Mammalia By Herbert McLean Evans and Olive Swezy Pp v+119 224+plates 19 86 5 00 dollars (Berkeley, Calif University of California Press)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 83 Descriptions of New Birds from Peru and Bolivia By M A Carraker, Jr Pp 455 467 A New Race of *Turdoides gardneri* from Buchananaland By Rodolphe Meyer de Schauensee Pp 469 470 (Philadelphia)

## CATALOGUES

Cambridge Electrical Instruments Abridged Specifications (List No 163) Pp 36 (London Cambridge Instrument Co, Ltd)  
Moll Micro Galvanometer (Galv 32) Pp 12 (Delft P J J Kipij and Zonen)

A Short List of Books relating to Scotland and Sir Walter Scott Pp 10 Perry Tracts (Catalogue 545) Pp 54 (London Francis Edwards, Ltd)



SATURDAY, FEBRUARY 27, 1932

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## Museums and the Schools \*

A SMALL pamphlet recently prepared by the Board of Education is of greater importance than its appearance might suggest, in that it brings the whole weight of the Board to bear in favour of the more extended use of museum materials by the various educational establishments of England. The pamphlet begins with a short historical summary, leading to a condensed survey of the present position, it then illustrates its aim by examples from the United States, Germany, Scandinavia, England, and Wales, and finally it indicates methods of co-operation already followed in isolated places as worthy of general adoption. Since no one seriously interested in either museums or practical teaching need grudge the small sum asked or the short time required to buy and study the booklet, it would be inadvisable to prevent him by any more detailed abstract of its contents. The publication does, however, suggest comment on a few of the broader matters involved.

The general question is the use of actual concrete objects in teaching as opposed to mere words. This has of late years been termed 'visual instruction'—obviously an inexact phrase, for 'visual' applies equally to book learning but does not apply to the handling of objects by the blind, which is merely an extreme case of the handling recommended for all pupils by the pamphlet. The use of this concrete method has undoubtedly spread with increasing rapidity during the past half-century, both up from the kindergarten and down from the laboratory. As regards the extremes of the educational scale, not much requires to be said: they have recognised their needs and have provided for them. It is for the intermediate region that missionary work and practical assistance are now desired.

The museums formed by various departments of universities, by art schools, and by technical and commercial colleges serve adequately the wants of those special students for whom they are designed. It is, however, suggested that the material in those semi-private museums might sometimes be made more accessible to the public, and that there might be more co-operation between those institutions and the public museum of the locality. At present it is the schools of art, craft, and trade that make most use of the public museums, the curators welcome visits from such students, and occasionally receive in turn some help in their installations from

\* Board of Education Educational Pamphlets No 87 Memorandum on the Possibility of increased Co-operation between Public Museums and Public Educational Institutions Pp 45 (London H M Stationery Office, 1931) 9d net

the art people. With scientific material the case appears to be different. Curators would no doubt be grateful for more of such help in the determination and classification of their specimens as university professors could render, but when there is a question of a *quid pro quo* it is found that methods of exhibition well adapted to the serious student are not always such as appeal to the public, while it is dangerous to admit pupils—and, sometimes, even professors—to the run of the cases and the free handling of material. With good will and a sympathetic understanding of each other's difficulties, much more could be done to mutual advantage, but in general the best plan is to have distinct collections for distinct purposes.

It is, however, the utilisation of museum material by the secondary and elementary schools that demands chief consideration. It is assumed that almost every school subject, even the teaching of a foreign language (living or dead), may be enlivened by the introduction of illustrative objects. The first question, then, is the provision of such objects. The richest and, in many cases, the only possible source of them is a well-stocked museum, and thus the problem becomes the best means of bringing the class and the collections into profitable contact. Either the school may send its pupils to the museum, or the museum may send specimens to the school. There is much to be said for and against both methods.

Consider, first, visits to a museum. It is plainly the main duty of a curator to place and keep in good order the specimens in his charge. So far as their educational use is concerned, it is his business to display attractive series that shall by arrangement or labelling tell their own story. One consequence of this is that the lesson of the specimens is most easily apprehended in a museum, where also each exhibit is, or should be, seen in its due relation to allied material. The pupils may at the same time be stimulated by the visit, and may be impressed by the surrounding neatness and order. On the other hand, it is maintained by some that the unfamiliar surroundings are distracting, and that the multiplicity of objects hinders concentration. Some museums, therefore, remove objects to a room set aside for teaching, and this enables the specimens to be handled, but only if they are duplicates provided for the purpose. By this compromise the pupils lose some advantages of a museum visit, while the curator and his collections are wrested from the primary purpose of the ordinary museum. The real objection, however, lies in the difficulty of bringing the classes, especially

those from a distance, to the museum, and in the impossibility of each pupil coming to the museum often enough for the visit to take its desired place as a normal part of the curriculum.

We seem, then, to be thrown back on the other method, that of circulating small collections and specially designed exhibits to the schools. Started in Great Britain half a century ago, the method has received remarkable extension in the United States. If it has not grown in Britain in like degree, that is largely due to the lack of interest shown by education authorities. The Museums Association has lately sought to arouse them to a sense of its value, and the present benediction of the Board will doubtless help it forward. Admirable work is being done by several museums on these lines, and success is found to follow expenditure of thought rather than of money. But here again, if every school is to have a supply of material available at the right moment for the appropriate lessons, the number of circulating collections must be multiplied a hundred-fold. At present the collections serve as occasional stimuli, of great value, but far from satisfying the everyday demand. This method, moreover, makes a still greater call on the time of the museum staff, and usually necessitates the acquisition of fresh specimens for the particular purpose. To obviate some of its disadvantages, the Commercial Museum of Philadelphia has replaced circulating loans by gifts of large numbers of identical cases.

Thus we are led to a third method, the formation of school museums. There are many school museums, some excellent, several disreputable, but few on the lines required. What is needed is a collection formed in each school with definite reference to the curriculum. In the establishment of such a collection the pupils themselves should help, guidance and some material can be obtained from the regional museum, and there are other sources from which appropriate specimens can be drawn, but, above all, every teacher should make use of it.

The last remark reminds us that, whatever method be adopted, the immediate task is to teach the teachers. Teaching is their business, it is not the curator's. The use of illustrative objects is more and more being inculcated in the training colleges, and to those who are thus trained the curator can explain the material he sends out and can suggest its use.

To sum up the scheme that seems to be most practicable and promising the best results is a combination of all three methods.—The museum of



the school, in which the school should take a pride, and which should be used to the full in class teaching as well as for spare-time hobbies circulating loans to illustrate some particular, temporary subject, in supplement to the school collections finally, as a reward and additional stimulus, a visit (if possible once a term) to the regional museum, this should be prepared for and should be under trained guidance. It will be long before such a scheme can be in working order, but it is the goal we would set before our educational museum enthusiasts. Meanwhile there are many things that can be done, on which space forbids us to dilate here. Some of them will be found in the excellent pamphlet that is our text.

### Science and Human Life

- (1) *World Chaos the Responsibility of Science* By William McDougall Pp vi + 119 (London Kegan Paul and Co, Ltd, 1931) 3s 6d net
- (2) *The Scientific Outlook* By Bertrand Russell Pp 285 (London George Allen and Unwin, Ltd, 1931) 7s 6d net
- (3) *What Dare I Think? The Challenge of Modern Science to Human Action and Belief, including the Henry La Barre Jayne Foundation Lectures (Philadelphia) for 1931* By Julian Huxley Pp ix + 270 (London Chatto and Windus, 1931) 7s 6d net

IN these three books a psychologist, a mathematical philosopher, and a biologist discuss the relation of science to human life. It is common ground that the application of scientific method has conferred enormous material benefits upon mankind—Prof Huxley's account of the triumphs of applied biology is particularly well done—but in all three writers one discerns a feeling of uneasiness lest science become too powerful and affect prejudicially the harmonious development of man's mind and character.

(1) Prof McDougall roundly asserts that the physical sciences are mainly responsible for the present world chaos, for they "have produced a complexity of our civilization which far outruns our present understanding and power of control." He would seek a remedy in more science, but in science of a different kind in a thorough study of social and economic problems from a definitely psychological point of view. This point of view would be completely different from that of the physical sciences—McDougall entirely rejects the mechanistic treatment of life and mind as inadequate, and substitutes his own conative or

hormic conception. His book is vigorously written, and his remarks on the present world crisis are extremely apt and timely.

(2) Mr Bertrand Russell has much more faith in the value of mechanistic methods in biology and psychology, and in effect denies that any other method is scientific. His psychological gods appear to be Freud and Pavlov. We venture to think that he has been over-impressed by the claims of mechanistic biologists, and that with greater knowledge would come a less dogmatic attitude. His book is an interesting one, and deals in a skilful way, and not without a certain dry humour, with the principles of scientific method. Chapters on scientific metaphysics and science and religion give him an excellent opportunity, of which he takes full advantage, to criticise Jeans and Eddington in their excursions into philosophy.

The most significant part of the book, in our opinion, is the short last chapter on science and values. It follows a vivid presentation of what the world State of the future might be like if it were organised on purely scientific lines—a picture which, Mr Russell agrees, is in some aspects nightmarish and depressing. Already in his introduction Mr Russell had pointed out that if "a scientific civilization is to be a good civilization it is necessary that increase in knowledge should be accompanied by increase in wisdom", meaning by wisdom a right conception of the ends of life. Science by itself can give no guidance as to values or ends. A society deliberately constructed on scientific principles, without regard to values, might then be a very bad society.

If we read Mr Russell aright, he views the possibility of a scientific world State with grave misgiving, and this because the power over Nature which science gives may come to be regarded as an end in itself. The love of knowledge, from which science springs, has, Mr Russell tells us, a twofold origin. "We may seek knowledge of an object because we love the object or because we wish to have power over it. The former impulse leads to the kind of knowledge that is contemplative, the latter to the kind that is practical. In the development of science the power impulse has increasingly prevailed over the love impulse" (p 270). "The scientific society of the future as we have been imagining it is one in which the power impulse has completely overwhelmed the impulse of love, and this is the psychological source of the cruelties which it is in danger of exhibiting" (p. 273). Power cannot legitimately be regarded as one of the ends of life, but merely as a means to

what the Greeks knew as 'the good life', if science, which is power, subserves the proper ends of human life, well and good, if it does not, disaster will follow

(3) These views, with which all thinking men will agree, are closely paralleled in Prof Huxley's discussion of scientific humanism. He agrees with McDougall that the rapid increase in scientific knowledge and the spread of the scientific spirit—meaning by this the predominantly materialistic method—are largely responsible for the chaos in thought which is characteristic of the present day

"The multiple contradictions sum up along these lines—that in the sphere of control over environment and destiny, man is through science being given fabulous and undreamt-of powers, yet is by no means agreed as to how to employ them. And that in the sphere of thought, while the scientific picture of the universe, in which naturalism and determinism rule, grows ever more triumphant and complete, yet it becomes ever more sharply set off from the world of values in which the human spirit inevitably has its being. Science, in a word, both in the outer and the inner life, has come up against human nature, and each seems in a strange confused way to be barring the progress of the other. Science and human nature—there lies the chief unresolved antinomy of the present stage of our civilization" (p 124)

The reader will find much to interest him in Huxley's extended treatment of this theme and in his sketch of a non-theistic religion compatible with evolutionary science

The problem raised in different ways in these three books is by no means a new one. It is certain that if science continues along purely naturalistic lines, if it rests content with the abstract and schematic treatment of reality from which it has derived so much of its practical power, it must remain apart from, and opposed to, the world of values

Science can in no case become an arbiter of values, but we may suggest that the antinomy of which Huxley speaks may possibly be overcome if a more concrete, more objective method establishes itself in biological and psychological research. If, for example, it can be shown that conation and perception are indispensable concepts in the study of animal behaviour, the way is opened towards a less abstract and analytical treatment of some at least of the problems of biology, and a bridge built across to the sciences of human psychology and sociology, upon the importance of which for the future development of civilisation McDougall rightly lays such stress

E. S. R

## International Geology

*International Geological Congress Comptes rendus of the XV Session, South Africa, 1929* Vol 1. Pp xiv + 314 + 42 plates Vol 2 *Scientific Communications* Pp x + 688 + 97 plates (Pretoria Wallach's, Ltd, 1930) 2 vols, 40s

THE two handsome and beautifully illustrated volumes which record the proceedings of the fifteenth session of the International Geological Congress, held in South Africa during July and August 1929, and the scientific communications there presented, constitute a worthy account of a meeting which was of outstanding importance because of the interest and success of the excursions and the high quality of the papers read. The first volume is occupied by minutes and official memoranda, and by long accounts of the excursions, enriched with a liberal photographic record. Those who attended the Congress will turn with renewed pleasure to these pages, while those who were unable to make the long journey will find in them verbal and pictorial compensation. The second and larger volume contains 78 papers, dealing with special subjects chosen for discussion and with general geology. In addition to the usual English, French, and German, two newly admitted languages, Spanish and Italian, appear on this occasion, accompanied, however, by summaries in English or French. The sections devoted to pre-Pleistocene glacial periods, the Karroo system, and rift valleys are of leading importance, and all contain contributions that substantially advance the boundaries of geological knowledge, particularly as regards the areal and historical geology of Africa.

Of all countries, so far as we know at present, South Africa is the richest in its evidences of early glaciations. Rogers summarises the indications of glaciation in the Witwatersrand and Transvaal systems and directs attention to a pre-Nama tillite in Namaqualand. A glacial band in the Table Mountain series is described by Haughton. The world-famous Dwyka glaciation is appropriately dealt with by du Toit in a summary account that is a model of its kind. He shows that there were several glacial phases which probably began about the end of the Lower, and died out not later than the close of the Upper Carboniferous. Turning to Asia, Norin records the discovery in 1928 of late-Palaeozoic glacial deposits in the mountains bordering the Tarim Basin on the north, and Backlund describes a probable tillite of similar age from the northernmost Urals. These lend weight to Gortani's

contention that no amount of continental drift will serve by itself as a primary explanation of pre-Pleistocene glacial epochs, even though the drift hypothesis may be necessary to provide an escape from the obvious geographical difficulties. Gortani favours fluctuations of solar radiation as the fundamental cause of terrestrial climatic variations. Lower Cambrian tillites occurring in the Yenisei Ridge of Siberia were examined in 1927-28 by Nicolaev, who presents a convincing and well-illustrated account of their glacial characters.

The Karroo rocks of Africa and their correlation are ably dealt with by Dixey. In the South African basin, these formations reach a thickness of 26,800 feet. In the Shire-Lower Zambesi area, 18,000 feet is reached. This province of the Karroo is admirably described by Dixey in a separate paper. The Rhodesian basin (Wankie-North Nyasa) contains a maximum thickness of only 4200 feet, this area, and the Tanganyika basin near Tanga, where 10,000 feet of Karroo sediments occur, are also described by Mennell. Teale shows that the so-called 'Tanganyika system' includes Karroo rocks, and possibly Waterberg and Transvaal formations. The basin of the Belgian Congo, which encloses the largest known outcrop of the Karroo in Africa, is dealt with in great detail by Fourmarier.

The Abyssinia-Somaliland occurrences are mentioned by various authors, and notably by Stefani. Range describes the Karroo of South-West Africa with special reference to its flora and fauna. Borges and Mouta give an account of the Angola representations of the system, accompanied by a coloured geological map of the south of Angola. The widespread prevalence of the Stormberg basalts, with rhyolites in association in many areas, is a remarkable feature that is well brought out by the papers and maps of this section. A short review of the Karroo flora is given by du Toit, with a hypothetical continental restoration showing the distribution of the chief genera in the various members of Gondwanaland. Walkom compares the fossil floras of Australia with those of South Africa, and Haughton deals with the Karroo Reptilia.

A most important discussion of the African rift valleys is contributed by Wayland, with a tectonic map of Uganda. He finds the tension hypothesis to be untenable, and gives much additional evidence supporting the alternative hypothesis, for which he was originally responsible, that the Western Rift and the uplifted massif of Ruwenzori are the result of deep-seated compression. A valuable systematic

study of the geomorphological aspects of rift-faults by Johnson provides a series of pictures of all the leading possibilities, which should aid the field geologist to find the critical evidence required for correct interpretation in any particular case. The European *graben* are discussed by Seidl and Seidlitz, the latter adding much new information about those of Syria and Erythraea. Van Rhedan deals with the buried graben of South Limburg. Harrison describes the Magdalena trench of Colombia, this is 400 miles long by 40 miles wide, and is 4000 feet deep. It broke in during the early Tertiary, and volcanic activity has been prevalent, and still continues, along the western edge.

The section on magmatic differentiation is disappointing in that no new conclusions of petrogenetic significance are reached. Niggli gives a general discussion, Reuning presents a chemical study of the magmatic provinces of South and South-West Africa, and Vardabasso deals with the Predazzo province. The latter is interesting in that it provides evidence that masses of Permian quartz-porphyrines were probably regenerated as granite in Tertiary times. In the General Section a study of the noritic lopolith of Sierra Leone is recorded by Junner, with many new analyses by Harwood and Theobald. The structure and mineralisation of the Kambone copper mine in Katanga is described with a wealth of illustration by Schulling, and the copper zone of the Katanga-Rhodesian frontier is dealt with more broadly by Thoren.

The geology and tectonics of North Africa and adjacent regions are considered in a series of papers by Russo on the relations of the Rif to the Atlas and the Betic Cordillera, Neltner on Morocco, Maddelena on the Jurassic submarine volcanic rocks of Sicily and the tectonics of Sicily and Tunisia, and Solignac on Tunisia as a whole. French Indo-China is well described by Blondel, Portuguese East Africa by Freire d'Andrade, and the Central Massif of France by Demay.

In the section on petroleum, Sacco again suggests an inorganic origin for the petroleum of Italy, basing this view on the association with plutonic and volcanic rocks and, in Sicily, with beds of sulphur. Fabian records his belief that the petroleum of Sicily has a deep origin, and that it migrated during the Pliocene through highly folded and faulted pre-Triassic rocks that are otherwise impermeable. Other papers deal with the geological work of micro-organisms, and with the modern floras of the Pretoria and Vryburg districts in relation to the local geology.

An announcement of the greatest interest is made by Kovaloff in the course of an account of the present spectacular activities of the Russian Geological Committee. For 1932-33 the Five-Year Plan allows nearly £6,000,000 for geological work, and 1300 field parties are expected to be engaged in survey and economic investigations. A doubt is expressed as to the possibility of finding the number (3200) of qualified geologists required. In 1928-29, 950 geologists were at work, and the practical results already achieved demonstrate, on a scale hitherto unprecedented, that geological research is a fundamental necessity to national welfare in general and to industrial progress in particular.

### Experimental Teratology

*Connecting Laws in Animal Morphology* Four Lectures held at the University of London, March 1929. By Prof Hans Przibram. Pp 62 + 8 plates. (London: University of London Press, Ltd, 1931) 4s 6d net.

THE future historian of biology will doubtless count among the more important tendencies of the first quarter of this century the extended application of the experimental method to all kinds of biological problems. More especially the phenomena of growth and form, which previous generations had, for the most part, been content to observe unfolding in Nature, are now studied in the modifications induced under artificially controlled conditions. In this department of research, Prof Hans Przibram has been one of the pioneers. Some twenty-five years ago he founded in Vienna a Biological Experiment Station, provided with arrangements for keeping large numbers of living animals under constant and carefully adjusted conditions. A long series of important researches have since been carried out at this institution by him and his pupils.

In 1929, Prof Przibram gave a series of four lectures in University College at the invitation of the University of London, and he has now published these under the title "Connecting Laws in Animal Morphology". Those who had the good fortune to hear these lectures, and many who had not, will welcome in this permanent form the exposition of what this distinguished representative of the experimental school regards as the most significant results obtained by the experimental method.

The first lecture, on "Organisation", deals with 'the increase in differentiation' as shown in the

modelling of a limb out of a formless mass of undifferentiated cells in the regeneration of a crustacean's claw. The 'reversal of asymmetry', discovered by Przibram in 1900 to take place after the removal of the large claw in certain prawns, is interpreted as showing "the advantage of an earlier start". In those decapod Crustacea in which the claws are of different form and size on the two sides of the body, the larger, more specialised claw has simply outstripped in growth its smaller, more primitive partner. If it is sent back to the starting-point by amputation or autotomy, the smaller claw takes the lead and, with increased size, attains increased differentiation.

This example serves to show at once the strength and (as it seems to an old-fashioned systematist) the weakness of the experimental method. It will not be disputed that Przibram has made good his claim to have discovered a 'connecting law' in animal morphology. His experiments have defined one of the conditions under which asymmetry reveals itself. He shows that, other things being equal, increasing size is accompanied by increasing differentiation. So far as they go, his conclusions rest on a secure basis of fact. But, do they go very far? Have we really learned anything as to the origin or the nature of asymmetry? The systematist, studying the bewildering complexity and variety of the forms assumed by the large claw of the alpheid prawns, for example, will feel little satisfaction in the explanation that it is more complex because it is bigger than its fellow. Is the very indistinct photograph of *Alpheus* which the author thinks good enough to illustrate his results a symbol of his undue simplification of the problem?

The lecture on "Growth" discusses the fact that in a number of arthropods the ratio of increase in linear measurements at each ecdysis is approximately 1.26, that is to say,  $\sqrt[3]{2}$ . Przibram is so impressed with this evidence of the doubling of mass (confirmed in some cases by weighing) that he calls 1.26 "the magic number". "Doubling of mass in the living being we may then assume to be the counterpart of chemical mass-action: the product of reaction being proportionate to the molecules involved." Perhaps the biochemists may find this statement satisfying. What the simple zoologist fails to understand is why this doubling of mass should be associated with ecdysis. The association is not invariable. Przibram, it is true, dismisses as abnormal the cases of starved or injured animals which go on moulting without increase (or even with diminution) of mass. But is the correlation so close

and so invariable even in normal growth? If it is not, a good deal of the magic will have faded from  $\sqrt[3]{2}$

Prof Przibram in his preface mentions "quantitative formulation" as one of the prime necessities for the building up of biological theories. We are reminded of Eddington's remark "by the time the serious application of exact science begins we are left with only pointer readings." But all pointer readings are not necessarily significant, and the half-mystical contemplation of numerical relations has before now led biologists into the wilderness.

The other lectures similarly leave one with the impression that experimental morphology (or experimental teratology) does indeed provide conclusive answers to the questions dealt with, but fail to convince one that these questions are always of primary importance. At all events, there is no need, yet awhile, to lay aside as useless the older methods of comparative morphology and taxonomy.

W T C

### An American Palæontologist

*Cope, Master Naturalist the Life and Letters of Edward Drinker Cope, with a Bibliography of his Writings classified by Subject, a Study of the Pioneer and Foundation Periods of Vertebrate Palæontology in America*. By Henry Fairfield Osborn, with the co-operation of Helen Ann Warren. Pp xvi + 740 + 24 plates. (Princeton, N.J. Princeton University Press, London Oxford University Press, 1931) 22s 6d net.

THE modern school of vertebrate palæontology in North America has achieved such remarkable results that its history cannot fail to be of interest. When this is combined with the life-story of perhaps the most brilliant of the three pioneers who started it, the narrative becomes still more absorbing. We are therefore much indebted to Prof H. F. Osborn for the labour he has bestowed on the handsome volume in which he describes the life and labours of Edward Drinker Cope and determines his place in American science.

Cope, who was born in 1840 and died so long ago as 1897, was an observant naturalist from early childhood, and, until misfortune overtook him in the 'eighties, was well provided with means to follow his inclinations. Even then his enthusiasm never failed, and a call to a professorship in the University of Pennsylvania enabled him to pursue his researches to the end. He began his studies of

fossils just after Darwin had convinced the scientific world of the truth of the doctrine of organic evolution, and he was always trying to recognise pedigrees among the successive extinct animals which were revealed by the fossils he collected. In a general pioneer way he met with much success, and his two volumes on "The Origin of the Fittest" (1887) and "The Primary Factors of Organic Evolution" (1896) summarise the many new facts and ideas with which he enriched palæontological science.

Prof Osborn begins with an interesting chapter on the early students of American vertebrate fossils who preceded Leidy, Cope, and Marsh. He then tells the story of Cope's life and work, mainly by well-arranged extracts from Cope's own letters to his family. A chapter follows on "How Cope earned the Title of Master Naturalist", and this affords an opportunity of discussing the main features of Cope's contributions to natural science, with some reference to his attitude towards education, sociology, politics, and religion. The next chapter is devoted to the personal reminiscences of Prof Osborn during his twenty years' association and friendship with Cope. The last hundred and fifty pages are occupied with a useful list of Cope's very numerous writings, classified under subjects.

Cope was associated with Philadelphia for the whole of his life, and belonged to the Quaker community. Most of his letters reflect his upbringing, and some portions are beautifully expressed. His quarrelsome rivalry with Marsh, however, occasionally led to outbursts which he could scarcely have wished to be preserved in print, and our only criticism of the book is that the account of the Cope-Marsh controversy might have been judiciously curtailed.

A S W.

### Colloids

*Colloids*. By Dr Ernest S Hedges. Pp vii + 272. (London. Edward Arnold and Co., 1931) 12s 6d net.

DR HEDGES' book is by way of being a *tour de force*. He has taken a subject the development of which has involved the use of a not inconsiderable mathematical apparatus, and has discussed it, lucidly and very fully, without the use of a single mathematical symbol, save when, on occasion, he quotes a formula as a shorthand way of stating a result.

There is much to be said for the method. We are apt nowadays, when gazing full of awe at an

imposing mathematical structure raised on a few premises of doubtful validity, to forget the truth that underlay Sir William Hamilton's attitude towards mathematical studies. After all, mathematics can become (and very often confessedly is) a mechanical routine, designed to save thought rather than to promote it. Such a mechanical exercise is a dangerous habit for a student of physics. True, the opposed habit of picturing mechanical models and 'explaining' phenomena in terms of them is not without its dangers, but, tried by a pragmatic test, it probably comes off best. Dr Hedges' attitude is well summed up in his own statement that a mental image of the processes involved is best obtained "not by regarding the colloidal system as the unit, but rather by considering the processes from the point of view of the colloidal particle itself. Only by getting down to the colloidal particle . . . in imagination can this vivid picture, which is essential to the proper understanding and appreciation of colloid chemical principles, be obtained."

From this point of view Dr Hedges discourses on polyphase systems, the formation of colloid particles, the general characteristics of colloid systems, methods of colloid investigation, the electrical properties and the stability of colloids, hydrophobic and hydrophilic colloids, and the detailed properties of gels. These last-named properties are discussed at considerable length, inasmuch as "natural colloids appear more often in the form of gels than sols, and biological and other reactions normally take place in gels."

The volume closes with a short chapter, which we should like to see considerably extended, dealing with such practical applications of colloidal principles as may be included under the headings clays and soils, dyestuffs, leather, milk, wool, water purification, sewage disposal, and so forth. It will be seen that flotation processes are not discussed, and, if we may venture a criticism, the sections which deal with surface forces are more sketchy than any others in the book and might very well be elaborated.

The book as a whole may be commended. It would be a mistake, in a new edition, to destroy its essentially non-mathematical character, nevertheless, we hope that, should a new edition be called for, Dr Hedges will, for the benefit of the weaker brethren, add a mathematical appendix which shall deal briefly with such topics as adsorption, the Brownian movement, and surface energy.

ALLAN FERGUSON

No 3252, Vol. 129]

## Short Reviews

*Newton the Man* By Lt-Col R de Villamil  
Pp vi + 111 (London Gordon D Knox)  
3s 6d net

THIS book has two outstanding and most valuable features. Col de Villamil has, by a piece of fortunate and painstaking research, found the detailed inventory of Newton's effects that was compiled by virtue of the Commission of Appraisal under the seal of the Prerogative Court of Canterbury on April 18, 1727. To the student of Newton the book is fascinating reading, throwing as it does the most intimate light on the later environment of England's greatest man of science. The dominant note is crimson frugahty! Luxury and æsthetic taste are conspicuously absent. We know from Humphrey Newton that Newton was the reverse of self-indulgent, and also that in matters of personal appearance he was careless, not to say definitely untidy. The inventory suggests that these general characteristics persisted all his life, even in his later years of affluence.

Perhaps the most important item in the inventory is the library. That catalogued in the British Museum and known as the Huggins Catalogue represents the books purchased by Huggins at the time of Newton's death. For nearly two hundred years all trace of this library has been lost, but, thanks again to the industry of Col de Villamil, a very large part of it has been rediscovered and examined. He had the good fortune to find the Musgrave Catalogue of a library that comprised a large number of volumes from the original Newton library purchased by Huggins.

A careful comparison of these two catalogues shows that many volumes which appear in the Huggins are absent in the Musgrave Catalogue. What has become of them is a complete mystery, but one most important fact emerges from the later discovery. The books in the Musgrave Catalogue (compiled about 1760) have all been carefully 'press-marked', consequently, the appearance of this 'press-mark' in any isolated volume is sure evidence that it originally formed part of this library. In fact, Col de Villamil has already been able to identify one stray volume by this particular evidence.

The book is a real contribution to the literature of the history of science. V E P

*Chaucer on the Astrolabe* With the Original Illustrations. Second and abbreviated edition revised by R T Gunther. Pp iv + 92 (Oxford R T Gunther, 5 Folly Bridge, 1931) 7s 6d net

THIS is a reprint in a separate form of Dr Gunther's modernisation of Chaucer's treatise on the astrolabe, which formed part of vol 5 of his series, "Early Science in Oxford", reviewed in NATURE for April 12, 1930 (p 556). A few verbal alterations have been made, and the work has been entirely reset, so that his description of the work as a second edition may pass, though it is not bibliographically accurate. The book is of



importance, as its appearance coincides with that of the first modern astrolabe, and it is of interest to compare Chaucer's treatise with that of Prof Jenkin, who is responsible for the new instrument. Dr Gunther may justly claim a share in the revival of the astrolabe, and we may account it not the least of his services to science.

The instrument, as it is now offered to the public, is much simplified. It consists of a metal plate some eight inches in length to which is attached a circle with the various graduations and arcs of the 'mother', substantially as described by Chaucer. Concentrically with this, a transparent plate with its appropriate graduations and circles revolves over it. Finally, a revolving transparent rule with ebony sights enables an observer to read off the angular altitude of any object on the scales of the astrolabe. On a previous occasion we have remarked on its utility—"nearly every instrument used for observation in Physical Astronomy is a part of a perfected astrolabe"—and though the modern instrument is by no means as decorative as a medieval astrolabe, it should, under the direction of a competent teacher, be a first-rate introduction to the practical study of astronomy.

The placid ignorance with which the modern city-bred man contemplates the heavens is a standing reproach to our schools and colleges. Dr Gunther's work reminds us of the estimation in which a knowledge of the subject was once held, let us hope that his efforts will reinstate it in the favour of our educational authorities.

*Communication Networks*. By Prof Ernst A. Guillemin. Vol. 1. *The Classical Theory of Lumped Constant Networks*. Pp xii + 425. (New York: John Wiley and Sons, Inc., London: Chapman and Hall, Ltd., 1931.) 25s net.

WE think this book will help forward the theory of the steady and transient currents which occur in communication networks. The author is obviously thoroughly at home in higher mathematics. He points out that, if research is to progress, new methods of attacking the network problems that occur in practice must be devised. After starting with general remarks on mathematical methods and analogies, he inserts two chapters on the simple mesh circuit before he gives the fundamental principles. Although perhaps illogical, it is an excellent method of introducing the subject, as the reader can then see the reasons for the procedure in the general case.

No proof is given of Heaviside's formula, as it would presuppose too great a knowledge of advanced theory. The author points out that Heaviside's formula is not a quick method of getting the complete solution. It involves the same amount of mechanical labour as the classical method. But it is an extremely compact method from the point of view of analytic form. In practice it is not much used, but in research work, when the properties of complicated networks have to be investigated, it is very useful owing to its compactness. We are looking forward to the second volume, where the author will discuss the classical theory of lines, cables, and filters.

*Die Schadlingsfauna Palastinas unter besonderer Berücksichtigung der Grossschadlinge des Mittelmeergebietes*. Von Dr F. S. Bodenheimer (*Monographien zur angewandten Entomologie. Beihefte zur Zeitschrift für angewandte Entomologie*, herausgegeben von Prof Dr K. Escherich, Nr. 10). Pp xv + 438. (Berlin: Paul Parey, 1930.) 42 gold marks.

THIS volume forms a comprehensive monograph on the injurious insects of the eastern Mediterranean region. It is based in the main upon the author's own experience, during the past eight years, in dealing with the insect enemies of cultivated plants in Palestine. A very large number of individual pests are noticed, and the more important are discussed at length, with accounts of their biology and methods of control. The introductory chapters are concerned with general principles, and special reference may be made to those dealing with ecological and climatic factors. There are also sections dealing with the insecticides, pests of stored products, forest pests, and beneficial insects. A book of this kind should form a valuable stimulus to entomology in the Near East, and it can be recommended as being reliable and up to date in character. It is exceedingly well indexed and fully illustrated.

*Genetics and Eugenics: a Text-Book for Students of Biology and a Reference Book for Animal and Plant Breeders*. By Prof W. E. Castle. Fourth revised edition. Pp x + 474 + 66 plates. (Cambridge, Mass.: Harvard University Press, London: Oxford University Press, 1930.) 12s 6d net.

SIX years have passed since the third edition of this work appeared, but so rapid are the additions to knowledge of genetics, and so rapid also the changes of opinion of geneticists, that several alterations are noticeable. Polyploidy, parthenogenesis, artificial mutations, selection are all treated anew, and more is said of heredity amongst mankind; there is a fresh chapter on biometry and its calculations, and the bibliography of selected papers covers sixty pages. But the book is so well known as a concise and clear exposition of its subject, that it need only be said that the fourth edition improves upon its predecessors.

*The Mediaeval Latin Versions of the Aristotelian Scientific Corpus, with Special Reference to the Biological Works*. By S. D. Wingate. Pp x + 136. (London and Leamington Spa: The Courier Press, 1931.) 10s 6d net.

THIS scholarly essay on a very important question of history will be welcomed by all those who are interested in the development of science and philosophy. Dealing with actual facts, the author explains how the works of Aristotle came to be known to the West in the Middle Ages. He traces the Latin translations of the "Aristotelian Corpus" through the Arabic, Byzantine, and medieval versions, and discusses their merits and their influence.

T. G.

## The Cause of Cancer

DR W E GYE,\* rightly we believe, thinks that the problem of the causation of cancer is at present most likely to be solved by studying the malignant tumours of fowls first described by Rous twenty years ago. Ordinary mammalian tumours, either arising spontaneously or induced by tarring or other irritating procedures, can be transmitted from one animal to another only by transplanting living tumour cells. The Rous tumours are peculiar in that they can be transmitted by means of dead cells, by cell-free extracts, and by such extracts after they have been passed through fine filters which will detain ordinary bacteria. In other words the filtrates contain some carcinogenic agent which resembles an ultra-microscopic virus, and Drs Gye and Purdy now give an account of the multitudinous experiments which they have made in an attempt to ascertain the nature of this agent.

In Gye's original paper published in 1925, he advanced the view that the agent is made up of two factors—one, the virus, can be killed by chloroform or acriflavine, the other, the specific or intrinsic factor, is a labile unorganised substance easily destroyed by gentle heating. An extract inactivated by chloroform could be reactivated by the addition of an extract inactivated by heat. He also found that an extract of a Rous tumour which had been chloroformed could be activated by a heated extract of several mammalian tumours, and would produce a Rous tumour on inoculation into a chicken. Whence he concluded that there was a general non-specific virus which might cause any tumour if it could co-operate with the specific factor which was responsible for the maintenance of the characteristic histological constitution so definitely characteristic of all transmissible neoplasms. The virus was looked upon as an independent organism coming into the body from outside, the specific factor as something arising in the cells of the affected animal.

As the result of a great deal of further work, in which his exacting standard of technical rectitude is fully maintained, Dr Gye is still of opinion that this interpretation is in the main correct, but he admits that its original experimental basis has proved less secure than he had supposed. Extracts can be inactivated with certainty and regularity by mild heat, but he has found that the actions of phenol, acriflavine, and chloroform are less dependable and that extracts which have been treated with these antiseptics in such a way that they can be relied upon to be inactivated every time the experiment is tried cannot be reactivated by heated extract "Antiseptics", as he says, "kill the virus only a very little more readily than they destroy the intrinsic substance". Hence it is impossible to get a long series of consistent clean-cut results which will convince the

sceptic, though the mass effect leaves the author's own opinion much as it was.

Dr Gye then turns to immunological observations and describes a long series of experiments on the properties of the blood serum of animals which have been injected with tumour extracts. This section of the book (p 307 onwards) contains a great number of important and interesting data in a field which has been little explored, and their apprehension is greatly helped by exceptionally clear diagrams. A detailed summary is impossible, but the chief conclusion which emerges is that the sera of the inoculated animals contain two different antibodies, one of which renders an active tumour extract ineffective after it has been heated to 55°C for half an hour (that is, in bacteriological language, in the absence of complement), while the other neutralises the extract only if fresh serum (complement) is present. If there are two antibodies, there are presumably two antigens which confirms the original hypothesis of a dual agent.

A second discovery of moment is that the sera of goats repeatedly injected with extracts of normal chick embryos will neutralise active extracts of Rous tumour in the presence, but not in the absence, of fresh serum, and that this property can be abstracted from the sera by adsorption with minced chick embryo. Embryo also removes the antibody which needs the presence of fresh serum from the sera of goats inoculated with Rous extracts, but has no effect on the antibody which is active in the absence of fresh serum: the former is the antibody to the specific factor, the latter to the virus. Anti-Rous sera also inactivate extracts of other fowl tumours of quite different histological structure, which therefore presumably contain the same virus, in one instance this does not happen in the absence of fresh serum, and hence the virus is judged to be different.

Such in brief are Dr Gye's main results and inferences. He has much evidence in their favour, but there is obviously a good deal that needs further explanation, and the experiments do not always seem consistent among themselves. As he himself says, the method of testing by inoculating fowls is at best calculated to reveal only coarse differences, and the effect of some tumour extracts is complicated by the presence of elusive "inhibitory substances". The serum from normal guinea-pigs, goats, and fowls occasionally neutralises active extract, ducks injected with Rous extracts yield sera on which complement has no effect, rabbits generally produce no antibodies, goats generate both antibodies, a horse showed both antibodies and indications of a third. A goat immunised with Rous filtrates was bled on July 25 and the serum tested next day was found to be active only in the presence of complement (p 344), serum obtained from the same animal on June 30 and tested on Aug 29 neutralised well in the absence of complement.

It may be that curiosities and apparent dis-

\* The Cause of Cancer. By Dr W E Gye and W J Purdy. Pp. xiv+515. (London, Toronto, Melbourne and Sydney: Cassell and Co., Ltd., 1931.) 30s. net.

crepancies such as these are the necessary consequences of not having always an infecting extract of standard strength against which to test the sera, but it is difficult to get rid of a suspicion that the distinction made between the two antibodies is quantitative rather than qualitative, and that their relation to fresh serum is not that of immune body and complement as known in bacteriology. The whole narrative needs, deserves, and will doubtless receive detailed critical analysis. It is fortunate that the data are presented on such an ample scale that this is possible. The interpretation seems also in places to be inconsistent. Thus on p 354 it is pointed out that two goats injected with heated extract (that is, containing virus only) produced sera which were active only in the presence of complement and therefore contained antiviral bodies only, and that this assumption is in accordance with general bacteriological experience. It is difficult to see how this fits with the fact (p 361) that anti-normal-embryo sera are also active only if fresh serum is present. On p 421 the antibody which operates in the absence of fresh serum is definitely identified with the extrinsic factor, that

is, the virus. Nor is it possible to subscribe to Dr Gye's suggestion that his immunological experiments demonstrate that extracts of fowl tumours contain some antigen which cannot have originated in the fowl and must therefore be an extrinsic virus which he thinks is widely disseminated about the world. Immunological differences between proteins depend on differences in chemical structure rather than on differences of biological origin, though in a rough way the two generally go together. Antigens from different species may be indistinguishable (blood serum of sheep and goat, egg albumin of duck and hen, various caseinogens), while antigens from the same species may be different (for example, the proteins of blood plasma or egg white) and the proteins of the lens of the eye may be antigenic in the individual to whom the eye belongs.

It seems evident that this part of Dr Gye's argument will not carry anything like the weight that he has put on it. What his observations do seem to show quite clearly is that part at any rate of the agent is intrinsic—a conclusion in good accord with the old-fashioned view that cancer is a local autochthonous disease.

### Scientific Research and National Life \*

THE sixteenth Annual Report of the Department of Scientific and Industrial Research covers the period Aug 1, 1930–July 31, 1931. It includes the brief report of the Privy Council, signed by the Right Hon Stanley Baldwin, and the longer report of the Advisory Council, over Lord Rutherford's signature, which surveys the development of the Department and emphasises the need for scientific method in industry. Summaries of the work carried out by the National Physical Laboratory, the Chemical Research Laboratory, the research associations, and under the direction of some forty-five research boards and committees are attached, together with appendices dealing with finance, publications, and the personnel of the various boards and committees. The report presents an impressive picture of the contribution which science is making to the major needs of the population, promoting not merely material development, but also the growth of a better and healthier social order. Not only the research associations, but also the long list of committees and boards, many of whose distinguished members are rendering voluntary service which is little recognised, may be regarded as a great general staff organised for the application of science to the myriad needs of modern society.

In view of the curtailment of expenditure by the Committee of the Privy Council, particular attention is attracted to the expenditure detailed in the present report. The gross estimate for the year is £740,520, of which £30,340 is for headquarters administration, but receipts amounting to £184,829 bring the net expenditure to £555,691. Grants for

research account for an expenditure of £40,610, gross, the Geological Survey and the Museum of Practical Geology for £67,714, and grants to research associations for £75,655. The National Physical Laboratory represents a gross expenditure of £208,964, of which slightly more than half, £104,706, is recovered as receipts from outside bodies and firms, the Air Ministry, and other government departments or special research funds. The Chemical Research Laboratory represents a charge of £19,993 net, building research, £30,421 net, fuel research, £87,411 net, radio research, £12,066 net, water pollution, £10,020 net. More than three-quarters of the expenditure of £50,060 on food investigation is borne by receipts, the net cost to the State being £11,693. Receipts amounting to £6936 similarly reduce the expenditure on forest products research to £36,376.

The expenditure on research associations, of which twenty-one received grants during the year, is of special interest. The seven largest grants, of £15,800, £8452, £8000, £7500, £6500, £4800, and £4750, are those paid to the Cotton, the Scientific Instruments, the Non-Ferrous Metals, the Wool Industries Research Association, the National Federation of Iron and Steel Manufacturers (Industrial Research Council), the Cast Iron Research Association, and the Research Association of the British Paint, Colour, and Varnish Manufacturers. The British Photographic Research Association was liquidated on Nov 7, 1930, and its functions have now been taken over by the research establishments of the rationalised photographic industry. Thus the total expenditure of £26,597 spread over twelve years has in this instance fully realised the objects of the Government scheme, and paved the way for

\* Department of Scientific and Industrial Research. Report for the Year 1930–31 (Cmd 3989) Pp iv+186 (London: H.M. Stationery Office, 1931) 3s net.

the future development of the research by the industry itself independently of financial assistance from the State. The report states "There can be no doubt that the important scientific investigations carried out by the research association during the period of its existence have materially contributed to the marked improvement in the quality of the photographic materials and accessories produced by British firms in recent years, and the Department has received an assurance that provision will be made under the new regime for the continuance of researches of this character."

The Wool Industries Research Association anticipates that the voluntary levy scheme will be working on normal lines next year. The Research Association of the British Motor and Allied Manufacturers is also being wound up, and its place is being taken by the Research and Standardisation Committee of the Institution of Automobile Engineers, which will receive grants from the Department up to a maximum of £2500 per annum for three years on a pound for pound basis in respect of income raised by the industry above £3000 a year. A further departure was the formation in November 1930 of the Printing Trades Research Association, which, however, is not in receipt of a grant.

Viewing the work of the research associations as a whole, the opinion is expressed that their achievements thoroughly justify the expenditure incurred, but the outstanding difficulty experienced by the research associations is that of bringing home to their members the practical significance of their work. This difficulty is being overcome, sometimes by the establishment of development departments, sometimes by the appointment of liaison officers.

Space does not permit even an outline of the work of individual research associations, and reference can only be made to a few features. The Cast Iron Research Association has developed the 'Sisal' heat resisting alloys which are finding successful use in industry, and the application of the knowledge of moulding sands and refractories acquired as a result of the Association's investigations represents an estimated annual saving to the industry of about £100,000 a year. The Non-Ferrous Metals Research Association has been responsible for important advances in the investigation of aluminium castings and in the comparative study of a range of bearing metals and their interaction with representative lubricants. Investigations carried out by the British Refractories Research Association to improve the durability of refractory materials have an interest not only to the ceramic but also to the iron and steel and other industries concerned with high temperature operations, while much of the work carried out by the Electrical and Allied Industries Research Association is definitely related to matters of public safety and economy, for example, in the factor of safety and design of overhead transmission lines in the 'grid' system, and in the laying of electric cables at considerable depth.

The Scientific Instruments Research Association records the interesting discovery that the effect of

polishing the surface of any glass, almost without exception, is to raise the refractive index of the immediate surface layer, an observation which should yield considerable information about the mechanism of polishing. The Paint Research Association has been concerned with the practical methods developed for the measurement of colour and the determination of colour fastness of pigments, and a table of fastness based on the quantitative methods developed is rapidly being accepted by the industry as the basis of colour valuation of pigments. X-ray methods are also being employed for the investigation of the structure of pigments, steels, metal deposition, and scales on steel.

The Cotton Industry Research Association has undertaken a long programme of fundamental studies on the physico-chemical nature of dye solutions and of the dyeing process, and these co-ordinated researches should fill a gap of much technical importance in our knowledge of the relation of the nature of dye solutions to the mechanism of cotton dyeing and the properties of the dyed material. In addition, laboratory work on the effect of various finishing processes such as bleaching and mercerising, and on the properties of cotton dyed with different dyes, is already yielding results of industrial value, and technical control of the bleaching process has been considerably improved. In a search for new uses for wool, the Wool Industries Research Association has obtained from a mixture of cellulose, leather, rubber, and wool, various products which closely resemble leather and for which uses are being explored. The Launderers' Research Association has succeeded in developing graded washing processes in which by technical control cleaner fabrics can be more rapidly obtained without increased cost of materials than by the casual processes commonly used, and methods for the economical cleansing of greasy fabrics are being evolved.

The Leather Manufacturers' Research Association has made an important contribution to public safety by the development of a method of disinfection which can be used by any tanner as a routine method of liming his goods and at the same time sterilising them against anthrax, attention is now being directed towards the development of a method by which the dry hides and skins may be disinfected at the port of entry into Great Britain. The Boot, Shoe, and Allied Trades Research Association is carrying out studies on the physical properties of leather which are intimately connected with the comfort and waterproofness of shoes. The Rubber Manufacturers' Research Association is assisting that depressed industry by discovering new uses for rubber, and particularly by studies on the use of vulcanised rubber for resisting corrosion and on the problem of securing satisfactory adhesion of rubber to metals, while the Research Association for the Cocoa, Chocolate, Sugar Confectionery, and Jam Trades has elaborated practical methods for preventing fatty bloom on chocolate and for overcoming the tendency of boiled sweets to become sticky on storage.

The above points, culled at random from the

summarised accounts of the activities of the research associations, represent in themselves an impressive and important contribution to public as well as to industrial progress. They are, however, only a fraction of the work for which the Department of Scientific and Industrial Research is responsible. Reference has already been made to the National Physical Laboratory, a feature of the work of which is the assistance rendered to industry by investigations and routine tests for industrial firms. Each of the seven main divisions of the Laboratory—Physics, Electricity, Metrology, Engineering, Metallurgy, Aerodynamics, and the William Froude Laboratory—is making valuable contributions to industrial progress, sometimes directly, sometimes through work carried out for a research board or association. The erection of equipment for the production of artificial fogs has much facilitated work in progress for the Atmospheric Pollution Research Committee, while the Engineering Department has carried out for the Ministry of Transport work of such obvious practical importance as tests on concrete for roads, skidding experiments with a motor-cycle and side-car and with a small model four-wheeled vehicle. The investigations on the spinning of aeroplanes, air-screw pressure and flutter, flutter of aeroplane tails, the wind resistance of ships, as well as the influence of waves on resistance, propulsion, and pitching, are only a few of the further ways in which the work of the National Physical Laboratory reflects on the question of transport and safety which is so vital in modern society.

The work carried out under the Fuel Research Board has received a considerable amount of attention recently, particularly that concerned with the hydrogenation of coal. Equally important, however, are the physical and chemical survey of the national coal resources, the investigations on carbonisation, gas production, treatment of tar to produce satisfactory fuel oils and motor spirit, coal-cleaning, and heat transfer which are proceeding quietly but steadily.

Transport, fuel, and atmospheric pollution are only three of the fields in which the work of the Department impinges broadly on daily life and needs. Important undertakings like the Southampton Docks and Water Supply, London Underground Railways, Battersea Power Station, the Millwall Drainage Tunnel, the Haweswater Reservoir Scheme, the Thames Tunnel, and the Mid-Scottish Ship Canal have resorted to the Geological Survey for information during the year.

The Building Research Board continues its efforts to substitute a science of building for empirical methods of trial and error, and has succeeded in formulating generalisations for the laying of wood block floors, as well as indicating causes of failures of paint coatings in buildings. Measurements of creep in the ageing of concrete have been supplemented by observations on actual structures, and other investigations endeavour to improve the efficiency of buildings from the point of view of the user. Research on steel structures has assisted in standardising practice for the design of steel-frame

buildings and also in the application of electric welding to structural work in Great Britain. Certain of the investigations under the Forest Products Research Board are of interest in the same field, notably those concerned with specifications for building timber, wood preservative, and the study of dry rot and the death-watch beetle, while metallurgical research on the effect of corrosive media on boiler steel under relatively severe plastic deformation is obviously of interest in regard to public as well as industrial safety.

Similarly, the public and industrial interests of work carried out under the Water Pollution Research Board are not easily separated. The investigation on beet sugar factories' effluent had already led to modifications in the factory processes, the cost of which was at least counterbalanced by resultant economies in other directions. Laboratory work has now indicated that certain organisms are of special value in the purification of waste waters containing sugar, while the surveys of the river Tees and the Firth of Tay have indicated that polluting matter is not readily carried out to sea unless it is in the surface layer when it reaches the estuary. The scarcity of living organisms in the middle section of the Tees estuary cannot be attributed solely to pollution, and observations are being recorded on the migration of salmon and sea trout smolts. Some of the work on water pollution is linked up with investigations at the Chemical Research Laboratory, where it has been found that base-exchange materials remove from water traces of undesirable metals such as lead, copper, and zinc, which may be present in solution. Apart from its other investigations on corrosion, low-temperature tar, etc., the Chemical Research Laboratory has also been responsible for investigations on a series of fluorene derivatives containing arsenic and a new group of arsenicals analogous to trypanamide, both of which possess promising therapeutic activity.

Much valuable radio research has been carried out on the propagation of waves, aerials for transmission and reception, direction finding, and atmospheric, the significance of which is obvious to an increasingly large proportion of the population, while lubrication, illumination, and dental research, and, until April 1, 1931, the preservation and restoration of exhibits in the British Museum are among other activities of the Department the public significance of which is obvious. In regard to the latter work, which has now been transferred to the Trustees of the British Museum, mention may be made of services rendered at the Persian Art Exhibition, the use of chloramine-T for removing stains produced by mould and mildew in water-colour drawings and engravings, as well as the use of vinyl acetate for strengthening porous and friable material.

No summary, however brief, of the work of the Department is complete without reference to the work of the Food Investigation Board. Some account of the investigations of this Board has recently appeared in our columns, and it is unnecessary to add more than that the work of the Food Investigation Board represents the only

serious scientific study of the possibilities of low temperature gas-storage of fresh fruit and vegetables, and its success has already led to the erection of several commercial gas-stores for apples. Problems connected with the corrosion of cans by fruit juices and syrups have been surveyed, the transport and storage of bacon and pork as well as freezing and storage of meat and eggs are all receiving attention, while it has also been found that temperatures below  $0^{\circ}\text{F}$  are required for the storage of brine-frozen haddock. Other investigations at the Torrey Research Station are concerned with the design of

plant for the extraction of liver oil on steam-trawlers at sea and for the smoke-curing of fish, and it is not too much to claim that the national importance of the food investigations of the Department alone justify a large proportion of the whole expenditure on scientific and industrial research. Certain it is that few fractions of the national income are more wisely administered or expended with more profit both to society and to industry than the comparatively small sums which are entrusted by Parliament to the Department of Scientific and Industrial Research.

### Obituary

#### PROF R STENHOUSE WILLIAMS

PROF R STENHOUSE WILLIAMS, first director of the National Institute for Research in Dairying, who died on Feb 2 at the age of sixty years, went to Reading in 1912 equipped for the study of the dairying industry with a thorough knowledge of bacteriology, a science for which he had the greatest reverence and the status of which he jealously guarded. His profession as a physician and his academic career assisted him in the broad outlook which he brought to bear on the industry of his adoption. As a medical man he realised the importance of the nation's milk supply, as a bacteriologist he was scandalised by the conditions which were associated with milk production, and as a teacher he deplored the apathy and ignorance which tolerated such conditions.

With a characteristic thoroughness, Prof Stenhouse Williams set himself to study the position, and brought his science and personal observation to bear on every stage in the passage of milk from the cow to the consumer. He did not content himself merely with working out scientific technique for the production of a clean and safe milk supply, he also realised the difficulties of the practical side and the necessity of keeping down the cost of production. It was here that his special gift of inspiring efficient social service came into full play. He became the friend of the farmer and of the milk distributor, inspiring in all with whom he came in contact the right mentality for their especial duties. Every grave error in the handling of milk he treated as a mistake which could be overcome by care and co-operation, and no hour of the day was too early or too late for him to give help and advice in cow byre or distributing centre.

Prof Stenhouse Williams realised the necessity for technical education in all branches of the milk industry, and was active in the organisation of lectures, classes, and competitions with the view of increasing both the knowledge and efficiency of the workers. He was a man of very clear vision. He saw the foundations on which the unique nutritional value of milk is established in the order of Nature, and demonstrated on a large and convincing scale that pure and safe milk could be produced as a practical proposition. He emphasised that the work of the research institute for which he was responsible should rest on the firm foundations of

fundamental science, and he stressed the necessity for a very thorough further study of the nutritional value of milk, including all possible effects produced by heat treatment. In his fight to maintain an open door for raw milk, many have crossed swords with him who could not have realised the soundness of his contention that the present necessity of harnessing the milk supply of our large towns to any processing machine is an expedient which must not exclude the recognition of a possible clean and natural milk supply under better conditions of social service.

Great and lasting as is his achievement in this work, it was the character and personality of Stenhouse Williams himself which endeared him to those who knew him well. To others, who differed from him, he presented an uncompromising front, for he was by nature a fighter.

#### PROF W H WATKINSON

WE regret to record the death, on Feb 14, of William Henry Watkinson, emeritus professor of engineering and director of the Walker and Harrison Hughes Engineering Laboratories of the University of Liverpool.

Prof Watkinson, who was in his seventy-second year, was born at Keighley. His early training in the University of Glasgow brought him under the direction of Lord Kelvin, and, under the latter and Prof Fleeming Jenkin, he aided in the manufacture, testing, and laying of trans-Atlantic cables. For a time he held a scholarship under Kelvin, and in 1888 was put in charge of the Engineering Department of the Central Science School, Sheffield. In 1893 he was appointed to the chair of engineering in the Glasgow and West of Scotland Technical College.

In 1905, Watkinson was appointed to the chair of engineering in Liverpool, and was largely responsible for the growth of that school. His efforts for engineering resulted in the building and equipment, in 1912, of the beautiful laboratories which he later directed. He was also instrumental in the foundation of the chairs of naval architecture and thermodynamics in Liverpool.

Watkinson's personal investigations related in particular to pioneer work on gas engines and air



heaters and superheaters for boilers. For twenty-one years he was a member of council of the Liverpool Engineering Society, and for a time served as president to the Society. He served also as chairman of the North-Western Branch of the Institution of Mechanical Engineers and as a member of its Council.

Watkinson will long be remembered for the kindness of his disposition and for the ceaseless efforts which he made to further the welfare of his School and the interests of his pupils.

WE regret to announce the following deaths.

Dr W. D. Dye, F.R.S., principal assistant in the Electrical Standards Department of the

National Physical Laboratory, on Feb. 18, aged forty-four years.

Dr James Mercer, F.R.S., fellow and lecturer in mathematics at Christ's College, Cambridge, on Feb. 21, aged forty-nine years.

Sir William Somerville, K.B.E., honorary fellow of St John's College, Oxford, and emeritus professor of rural economy in the University of Oxford, on Feb. 17, aged seventy-one years.

Prof J. A. Udden, director of the University of Texas Bureau of Economic Geology, known for his work in the development of the mineral resources of Texas, on Jan. 5, aged seventy-three years.

Prof Ernest Wilson, emeritus professor of electrical engineering at King's College, London, on Feb. 17, aged sixty-eight years.

### News and Views

#### Centenary of Jean François Champollion

ON March 4 occurs the centenary of the death of Jean François Champollion, the distinguished French Egyptologist, who first deciphered the hieroglyphics. Born on Dec. 23, 1790, at Figeac, in the Department of Lot, he was the younger brother of Jean Jacques Champollion-Figeac (1788-1867), the archaeologist and librarian. He was sent by his brother to school at Grenoble, and while there came under the influence of the mathematician Fourier, who had accompanied Napoleon to Egypt, and it is said that the sight of some Egyptian figures first aroused Champollion's intense interest in the East. From Grenoble he went to Paris to study Arabic and Coptic, at nineteen years of age he returned to Grenoble as a professor of history, and in 1811-14 published his work "*L'Égypte sous les Pharaons*", covering the whole history and geography of ancient Egypt. He was afterwards robbed of his chair for a time for political reasons, but, continuing his researches, in 1822 he wrote his important memoir on the hieroglyphics, which was read to the Institute, and two years later he was enabled by Louis XVIII to visit Italy to study the collections of Egyptian antiquities. His "*Précis du système hiéroglyphique*" appeared in 1824, his catalogue of Egyptian manuscripts in the Vatican in 1826, and his account of the discovery of the hieroglyphic alphabet in 1827. The following year, with some assistants, he made an expedition to Egypt itself, and on his return in 1830 was appointed to a newly founded chair of Egyptology in the Collège de France. His death took place at the early age of forty-one years on March 4, 1832, and he was buried close to Fourier in the Père Lachaise cemetery.

#### New Physics Building at Leeds

THE new physics building of the University of Leeds, described in NATURE of Jan. 9, p. 64, was formally opened by Sir William Bragg on Feb. 18. In introducing Sir William, the vice-chancellor of the University, Sir J. B. Baillie, referred to the brilliant work carried out by Sir William Bragg during his tenure of the Cavendish chair of physics at Leeds. He also

stated that although the greater part of the £60,000 spent on the laboratory was generously contributed by the public to the general building fund, two specially generous donors specifically ear-marked their gifts for physics—Sir James Roberts and Messrs Courtaulds. Sir William Bragg, in his address, discussed the change of attitude on the part of the general public during the past eighty years or so towards the work of the physical laboratory. There has been increased interest in the progress of natural knowledge and also in its application to everyday needs. At one time private benefactors alone founded and maintained learned institutions, nowadays, such institutions receive public grants. John Citizen has realised the value of the advance of knowledge by experiment, and is willing to pay for it. Sir William would now like to see him in the laboratory itself, and suggested that every opportunity should be taken "to demonstrate visually to John Citizen the slow unfolding of Nature's laws by patient research, the discovery of unsuspected beauties of order and adaptation, the origin of the new conception of the universe, and, not least, the skilful handling of new knowledge for the service and delight of man." Prof R. Whiddington, in moving a vote of thanks to Sir William Bragg, said he felt sure the new building would for a long time function efficiently and, by virtue of its internal conveniences and appearance, induce the right atmosphere for teaching and research. He felt one regret in leaving the old building to its fate: there was a hallowed corner where his famous predecessor, Sir William Bragg, had made historic experiments—this place would soon be covered by the Brotherton Library. He felt sure that it would be possible to mark the spot suitably when the library is built.

#### Presentation to Prof. W. W. Watts, F.R.S.

ON Feb. 3, a representative gathering of past and present members of staff of the Geological Department of the Imperial College of Science met for the purpose of presenting Prof. W. W. Watts with his portrait, painted by Sir William Rothenstein. A medal, to be known as the Watts Medal, was also struck as an additional mark of the occasion. This

medal, executed by Mr Percy Metcalfe, is to be awarded annually to the best student in geology in his final year, but the first copy was presented to Mrs Watts. In making the presentations on behalf of the fifty members of staff who have served in the Department of Geology during the last twenty-five years, Prof P G H Boswell recalled Prof Watts's high distinction as an original investigator, and referred to the great influence he has exercised on British geology in his time. Geology generally has benefited by Prof Watts's well-known capacity for organisation and administration and by his genius as a teacher, in which field he is *felicissime princeps*. Prof Watts, in returning thanks, acknowledged the encouragement and help he had received from his teachers and associates, and took the opportunity of announcing the establishment of a prize-fund in memory of his predecessor, Prof J W Judd. In a characteristically happy speech, he charged his old students and staff with having used, when they turned their microscopes on him, only low powers and parallel nicols, so that they saw a gorgeous display of colour, but failed to observe his angle of extinction.

#### Geology in International Affairs

ON Feb 18, Prof H. H. Read, George Herdman professor of geology in the University of Liverpool, delivered his inaugural address. In discussing certain aspects of geology, both national and international, Prof Read stated that the importance of mineral deposits in national and international affairs arises from three main factors, namely, the irregular distribution of minerals among the nations, their character as irreplaceable wasting assets, and the gigantic acceleration in their consumption. A survey of the present and future mineral position shows that the British Empire, provided it remains a unit of intelligent type, and the United States are together overwhelmingly dominant. The Empire's chief lack is petroleum, a circumstance giving added importance to the production of oil from coal. The dominance of these two units leads to the consideration of schemes for the prevention of war, similar to those suggested by Sir Thomas Holland. A mineral sanction, or an agreement by the United States and the British Empire not to export key minerals to disturbers of the peace would prevent, stop, or at least limit, war.

#### Blind Reading Print by Sound

SEVERAL devices have been invented with the view of enabling the blind to read ordinary print instead of Braille. As mentioned in NATURE of Jan 9, p 52, the 'optophone' was invented by Dr Fournier d'Albe and the 'phonopticon' by Prof F C Browne. These two instruments convert ordinary type directly into sound signals, but according to Dr Ernest Whitfield, of the National Institute for the Blind, London, neither is in use in any institution for the blind. We understand also that there is no alphabet requiring more training than one which converts printing into sound. The 'photoelectrograph' of MM Thomas and Conland, as announced in our note, involves touch; but since the Braille type part of the machine

would necessitate the printing of books in special type, it would involve a cost beyond the reach of the average blind person. We have also been reminded of other instruments for aiding the blind, including the 'optograph' of Dr J Butler Burke, which involves the use of a photoelectric cell to convert typewritten or printed matter into Braille, and also sets up type automatically, this instrument was exhibited at the Exhibition of Inventions in October 1929. Another instrument is the 'visagraph' invented by Mr Robert E Naumburg, of Cambridge, Mass. This latter involves touch, a ray of light passing over the printed page, and the letters are reproduced in embossed type on a sheet of aluminium foil. It may be remarked that embossed 'roman type' preceded Braille, and Dr Whitfield states that it was very successful. The 'visagraph' is being used successfully in America, thus showing that ordinary type is suitable for reading by touch with reasonable speed.

#### New Political Fellowship

THE present state of party politics has given an impetus to non-party movements such as the New Political Fellowship organised by Mr A G Pape, though it is perhaps premature to predict as the ultimate outcome the formation of a centre group in our Houses of Parliament. Party politics are apparently insufficient for the present emergency. The co-operative methods advocated by the New Political Fellowship, based on a definite planning of national and international life which is determined by an impartial study of the facts, not by political prejudice, are much more in harmony with the methods and outlook of scientific workers. The Fellowship, which already has a basis in some thirty countries, claims to break with useless traditions, and to substitute for the narrow, national jealousies a broad outlook and a spirit of co-operation which will enable existing international machinery, such as the League of Nations, the International Labour Office, etc., to function smoothly. However idealistic certain of the points in this policy may appear, they undoubtedly spring from the conviction that leadership must be based primarily on knowledge and no longer on prejudice or vested interests. In this the Fellowship can justly ask the support of men of science, without whose support its efforts indeed are likely to be largely sterile. It is only the solutions reached under the guidance of the calm impartial spirit of science that will have permanent value and authority in the era of co-operation which the Fellowship seeks to promote.

#### Charles II. Exhibition in London

THE period of Charles II is so intimately connected with the beginnings of some of our principal scientific institutions that it is satisfactory to record that the Royal Society, the Greenwich Observatory, the Old Ashmolean Museum, Chelsea Hospital, and Hudson's Bay Company, all dating from his reign, should be joining in contributing contemporary exhibits to the Loan Exhibition now being held at 22 Grosvenor Place, London. The scientific exhibits include the

reflecting telescope of Isaac Newton, a full-sized model of Hooke and Boyle's pneumatic engine or air-pump, Sutton's 16-inch planisphere, quadrants, and the adding machine invented by Sir Samuel Morland and presented to Charles II in 1666, from the Lewis Evans Collection in the Old Ashmolean at Oxford. Viscount Knutsford is showing his interesting screw-barrel microscope and 6-foot vellum-draw telescope by William Longland. The Royal Society has sent portraits of Sir Isaac Newton, Pepys, Evelyn, and Wren. Further attractive features are the fine clocks and watches made by Edward East with his apprentice Henry Jones, Fromanteel, Robert Seignior, and Joseph Knubb. The medical and surgical practice of the time is rather inadequately represented by a barber-surgeon's bowl and several drug-pots, but Capt Collins's "Coasting Pilot", exhibited by the Lords of the Admiralty, reminds us that the first hydrographic survey of the British Isles was also a product of the reign of Charles II. The exhibits are well arranged, and, not being crowded, can be well seen.

#### New Pyramid at Giza

THE discovery of a fourth pyramid at Giza, as reported in the *Times* of Feb. 18 and subsequent issues, is likely to provide Egyptologists with a historical puzzle, as well as presenting some peculiar and interesting features in itself. The method of construction would appear to be unusual, for it is said that the southern face, which looks on the valley and is much weathered, is cut out of the sandstone. Another remarkable feature is the enormous granite slabs lining the passage which leads to the interior of the pyramid, and equally interesting are the two windows facing east, which open from the entrance chamber. These, it is suggested, may be connected with the enhanced influence of sun-worship usually attributed to the fifth dynasty. The most striking feature, however, is the fact that the names and titles of the owner of the large chamber cut out of the rock on the south-east of the pyramid show that it belonged to Queen Khent Kawes, "King of Lower and Upper Egypt". The name is not enclosed in the usual cartouche, but is ensigned with a royal uræus. This title is not known to have been applied to any other queen of the Old Kingdom. The official communique suggests that, while not the actual ruler of Egypt, she may have been regent during her son's minority. It goes on to point out that it is possible that she may have been connected by birth with the fourth dynasty; but that otherwise it is singular that a pyramid should have been erected for her at Giza at the time of the fifth dynasty, which resided at Abusir.

#### Gallium, a Commercial Product

ALTHOUGH the presence of the metal gallium has been detected in a great variety of minerals, it occurs in such minute amount even in zincblende, which is its chief source, and its isolation is so laborious, that until quite recently only very small quantities were available. The *Chemiker-Zeitung* for Jan. 2 announces that the Vereinigte Chemische Fabriken at Leopoldschall, Stassfurt, manufacturers of the rare element

rhenum, have succeeded, after lengthy experimental trials, in isolating gallium by a method which enables them to produce the metal at one-twentieth of its former cost, which a year ago stood at about 175 gold marks per gram. Thus the way to the commercial development of this remarkable metal is at last opened.

CONSIDERABLE attention has already been given to the properties of gallium, chiefly on account of the long thermal range of stability of its liquid phase. Thus the pure metal melts at about 30° C and boils at a temperature above 2000° C. It has therefore been used for filling quartz thermometers for registering temperatures above 500° C. Some of these have already been sent to the Physikalisch-Technische Reichsanstalt for standardisation. Gallium can also be used to replace mercury in vapour arc-lamps for use in analytical work. Indeed, its application in this direction should lead to important results, on account of the wide range in frequency in the lines of its spectrum, which extend from the ultra-violet to well into the red region. It has also been used in the form of alloys with other metals to replace the dental amalgams, which are said to have produced some harmful results. Satisfactory results from gallium alloys have been reported. Gallium and some of its alloys can also be used for the production of special optical mirrors, and no doubt many other applications will be found now that the metal has become an article of commerce.

#### Earth Pressures

At the Friday evening discourse at the Royal Institution on Feb. 19, Prof. C. F. Jenkin discussed the mechanics of shifting sand. Prof. Jenkin explained why experiments intended to measure the pressure exerted by granular material, such as sand, fail, and showed that the failure is due to arching, a necessary consequence of the property of dilatancy, discovered by Osborn Reynolds. The latest design of apparatus for measuring the forces on a retaining wall was shown, and the results of a test made with it were described. With this apparatus the old earth pressure theories have been tested and the truth in them separated from the error. As a result, a revised wedge theory has been formulated. The apparatus was shown to be capable of measuring the forces not only on plane walls, of any batter, but also on stepped walls and on L-shaped walls, and also of measuring the forces under water. Finally, by an ingenious device, a wall of sand has been tested and the true friction angle between two sand faces measured. The reaction, that is, the force exerted by the wall on the sand, was described and its importance illustrated by an account of the partial failure of a great weir in Australia. The apparatus described can only deal with one-quarter of the whole problem of earth pressures; it cannot measure the forces under a foundation, and it cannot measure either horizontal or vertical forces exerted by clay.

#### International Co-ordination of Locust Research

SOME time ago the Imperial Institute of Entomology in London organised, with the financial support of the

Empire Marketing Board, special investigations on the distribution, breeding areas, migration routes, ecology, and bionomics of locusts in tropical Africa and Asia. An appeal was made by the British Government to the governments of other countries interested in the locust problem to help in these studies, and the Italian Government came forward with a suggestion to call together a meeting of experts to discuss the ways and means for a unified attack of the problem. The meeting, in which British, Italian, and French experts participated, took place in September last in Rome, and its resolutions, which have just been published, constitute the first step towards an effort to solve the locust problem on an international scale. The meeting expressed a definite opinion that the best and most economical method of preventing the ravages of locusts consists in the discovery of permanent breeding areas, and in the study of ecological conditions which lead to the outbreaks and invasions of cultivated areas.

SINCE in their migrations locusts do not respect political boundaries, the necessity of centralising all research on locusts in one institution was stressed at the meeting in Rome, and it was recommended to all the governments concerned that the Imperial Institute of Entomology should be recognised as the international centre of locust investigations. This decision has since been accepted by the Italian and French authorities. All current information on the appearances, breeding, and migrations of locusts are to be submitted periodically to the Institute, which will co-ordinate the data for the whole area of distribution of each locust species and study them in order to throw light on the factors governing the outbreaks and the main lines of migrations. All governments not represented at the Rome meeting, but interested in the locust problem, will be invited to co-operate with the central Institute, and annual meetings of experts will be arranged to discuss the progress made in each country in the study of locusts, and the programmes of future work. The next meeting of this kind is planned to take place in Paris at the time of the Fifth International Entomological Congress in July.

#### The Lapel Microphone

At public meetings and at lectures, the microphone and loud speaker is often a great boon to both the speaker, who speaks practically in his natural voice, and to the audience, who hear him clearly. There are some, however, who forget that they are addressing a stationary microphone and move about freely, with the result that sometimes they can scarcely be heard. To get over this difficulty, the Bell Telephone Company has invented the lapel microphone, a description of which is given in its *Record* for January. The microphone is only about an inch in diameter and weighs one and one-half ounces. A thirty-foot length of flexible cord provides the connexion to the amplifier of the public address system. The diaphragm is made of thin aluminium in the shape of a cone of sufficient stiffness to cause it to vibrate as a unit throughout the required frequency range. A rubber covering for the microphone eliminates the disturbing noise which would otherwise result from rubbing against the

speaker's clothing, or would be picked up through the clip which is provided for attaching it to the clothing. The best place to attach the clip is to the lapel of the speaker's coat. This device has been used very successfully in large auditoriums in America. It should prove useful to speakers who depend on gestures for effective delivery or who need to turn to explain lantern slides or use a blackboard.

#### Publications of the American Physical Society

COMMENCING with the first issue for January of this year, the *Physical Review* is publishing the titles of papers on physics that are appearing in a number of other journals. The value of this innovation is enhanced by the fact that arrangements have been concluded whereby many of these will furnish advance proofs of their tables of contents. The first list is fairly comprehensive, although one notices the omission of the *Proceedings of the Cambridge Philosophical Society*, and of a few others, which may, however, be rectified later. The American journals include, amongst others, the *Journals* of the Acoustical and Optical Societies, the *Journal of Rheology*, the *Review of Scientific Instruments* and *Physics*. This is the fifth comparatively recent change in the publications of the American Physical Society and follows the appearance of the *Physical Review* twice every month in place of twelve times in a year, the addition of a section in this for "Letters to the Editor", and the publication of the two new periodicals *Physics* and *Reviews of Modern Physics*.

#### Comité International d'Histoire des Sciences

THE fourth annual meeting of this Society, the second international congress of which, it will be remembered, was held in London last July, is to take place in Paris on May 13-16. The Council of the Society is convinced that one of the most important tasks confronting the historian of science is to study the development under Arabic influence during the period of its dominance, say from the date of the Mussulman conquest until the beginning of the sixteenth century. To promote and organise this study, the scientific sessions, as distinct from the business sessions which are confined to members, will be devoted exclusively to papers and discussions on Arabic science. In these sessions all those who are interested, members or not, are invited to take part and to submit papers. There will be five sessions, devoted to mathematics, alchemy, astronomy and physics, geography and cartography, and medicine respectively. The meeting will take place at the headquarters of the Society, Hôtel de Nevers, 12 rue Colbert, Paris, 2e, the permanent secretary, M. Aldo Mieli, will be pleased to furnish a programme and further details.

#### Progress of Agricultural Research

THE sixth of the series of annual summaries of scientific and economic research work in agriculture has been published by the Royal Agricultural Society of England, entitled "Agricultural Research in 1930". The survey which the volume contains is not limited to work done in Great Britain, but includes reference to the activities of experimental stations in all parts of the world, in so far as they have a bearing upon the

problems of British agriculture. The present volume follows upon the lines of the previous issues as to the seven departments of research covered, and each of these sections is compiled by an acknowledged authority on the subject. The volumes are issued free to members of the Society upon application to the Secretary, 16 Bedford Square, London, W C 1, and at a nominal charge of 1s 3d, including postage, to the general public. The Research Committee, under the direction of which they are prepared, is desirous that the information contained in them should be drawn upon freely by county agricultural advisory officers and by the Press, so that it may receive a wide publicity.

#### Economic Research in Australia

THE *Journal of the Council for Scientific and Industrial Research* of the Commonwealth of Australia contains reports of many investigations of pressing economic problems, to some of which reference will be made under our Research Items. Here we simply wish to congratulate the Council upon the completion of its new Animal Health Laboratory, the result of a sum of £20,000 given by Mr F. D. McMaster for that purpose. The Laboratory is placed within the grounds of the University of Sydney, alongside the buildings of the Veterinary Department, and the closest contact is maintained between the two staffs. The work already in progress in the building relates to internal parasites of sheep, including nutritional aspects of this problem, contagious mammites, certain aspects of foot-rot of sheep, and other problems. It is obvious that the Laboratory is in a position to play an important part in the study of those aspects of the Australian pastoral industry which are in great need of solution if the industry is to flourish. The building is of brick, with red-tiled roof, measures 155 feet by 43 feet, is two-storied, and has been constructed so that other stories or rooms may be added with the minimum of disturbance.

#### New Chief Entomologist at Rothamsted

THE position of Chief Entomologist at the Rothamsted Experimental Station, rendered vacant by the appointment of Dr A. D. Inms as head of the new Department of Entomology at Cambridge, is to be filled by Dr C. B. Williams, lecturer in agricultural and forest zoology, University of Edinburgh. Dr Williams has had a distinguished career as entomologist in various parts of the British Empire; he received his training at Cambridge and then at the John Innes Horticultural Institution, Merton. After a period of travel in Canada and the United States, he was appointed to the Department of Agriculture of Trinidad, in charge of frog-hopper investigations, where he stayed for five years. He then became sub-director and afterwards director of the Entomological Section, Ministry of Agriculture, Egypt, and after six years' service was appointed entomologist to the East African Agricultural Research Station, Amani, Tanganyika. He is shortly proceeding to the United States of America to give a course of lectures at the Agricultural Department of the University of Minnesota, and will take up his duties at the Rothamsted Experimental Station on July 1.

#### Fellowship of African Research

IT is announced that a Rockefeller fellowship for research work in Africa has been awarded to Miss L. C. Mair. Miss Mair has worked with Prof. B. Malinowski at the London School of Economics as research assistant. She has already left for Uganda, where she will study native social institutions with special reference to the changes which have been brought about by European settlement. The comparatively highly organised character of the social institutions of the Baganda before they came into contact with Europeans, and the readiness the people have shown in adapting themselves in certain directions to European ideas, should make this a fruitful and particularly instructive field of inquiry, especially if opportunity should arise for comparison with other areas of East Africa in which contact with European civilisation has been neither so prolonged nor so intense.

#### The Cuba Earthquake of Feb. 3

ACCORDING to the *Wire Reports* for Feb. 3 and 4 issued by Science Service, the epicentre of the Cuba earthquake of Feb. 3 lay in about lat. 19° 5' N, long. 76° 5' W, or about thirty miles from Santiago, on the northern edge of the Bartlett Deep. At the time of the earthquake, Prof. S. Taber was in Santiago, studying the seismology of the district. He has found faults near Santiago so fresh that gullies made by rain have not yet crossed them. The U.S. submarine *S-48*, carrying an international scientific expedition, left on Feb. 4 to study the depths and changes of depth in the Bartlett Deep, an inquiry that may add to our knowledge of the origin of the recent earthquake.

#### Announcements

THE thirty-seventh annual congress of the South-Eastern Union of Scientific Societies will be held in London, at the Civil Service Commission, Burlington House, W.1, by permission of H.M. Office of Works, on June 1-4, under the presidency of Dr R. E. Mortimer Wheeler, Keeper of the London Museum.

ON March 7, the Hon. Henry McLaren, president of the Royal Horticultural Society, will unveil a plaque at Messrs. Hatchards, 187 Piccadilly, London, to commemorate the foundation of the Horticultural Society of London at Messrs. Hatchards on March 7, 1804. The Society received its royal charter on April 7, 1809, becoming the Royal Horticultural Society.

AT the annual general meeting of the Quekett Microscopical Club, held on Feb. 9, the following officers and new members of the committee were elected: *President*—J. Milton Offord, *Vice-Presidents*—Dr G. H. Rodman, J. Wilson, C. D. Soar, and J. Ramsbottom, *Hon. Treasurer*—C. H. Bestow, *Hon. Secretary*—W. S. Warton, *Hon. Reporter*—A. Morley Jones, *Hon. Librarian*—C. H. Caffyn, *Hon. Curator*—C. D. Sidwell, *Hon. Editor*—W. S. Warton, *New Members of Committee*—J. T. Holder, C. H. Oakden, H. C. Payne, J. Richardson, W. P. Sollas, and Dr C. Tierney.

## Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

## Possible Existence of a Neutron

It has been shown by Bothe and others that beryllium when bombarded by  $\alpha$ -particles of polonium emits a radiation of great penetrating power, which has an absorption coefficient in lead of about  $0.3 \text{ (cm)}^{-1}$ . Recently Mme Curie-Joliot and M Joliot found, when measuring the ionisation produced by this beryllium radiation in a vessel with a thin window, that the ionisation increased when matter containing hydrogen was placed in front of the window. The effect appeared to be due to the ejection of protons with velocities up to a maximum of nearly  $3 \times 10^9 \text{ cm per sec}$ . They suggested that the transference of energy to the proton was by a process similar to the Compton effect, and estimated that the beryllium radiation had a quantum energy of  $50 \times 10^6 \text{ electron volts}$ .

I have made some experiments using the valve counter to examine the properties of this radiation excited in beryllium. The valve counter consists of a small ionisation chamber connected to an amplifier, and the sudden production of ions by the entry of a particle, such as a proton or  $\alpha$ -particle, is recorded by the deflexion of an oscillograph. These experiments have shown that the radiation ejects particles from hydrogen, helium, lithium, beryllium, carbon, air, and argon. The particles ejected from hydrogen behave, as regards range and ionising power, like protons with speeds up to about  $3.2 \times 10^9 \text{ cm per sec}$ . The particles from the other elements have a large ionising power, and appear to be in each case recoil atoms of the elements.

If we ascribe the ejection of the proton to a Compton recoil from a quantum of  $52 \times 10^6 \text{ electron volts}$ , then the nitrogen recoil atom arising by a similar process should have an energy not greater than about 400,000 volts, should produce not more than about 10,000 ions, and have a range in air at N.T.P. of about 1.3 mm. Actually, some of the recoil atoms in nitrogen produce at least 30,000 ions. In collaboration with Dr Feather, I have observed the recoil atoms in an expansion chamber, and their range, estimated visually, was sometimes as much as 3 mm at N.T.P.

These results, and others I have obtained in the course of the work, are very difficult to explain on the assumption that the radiation from beryllium is a quantum radiation, if energy and momentum are to be conserved in the collisions. The difficulties disappear, however, if it be assumed that the radiation consists of particles of mass 1 and charge 0, or neutrons. The capture of the  $\alpha$ -particle by the  $\text{Be}^9$  nucleus may be supposed to result in the formation of a  $\text{C}^{12}$  nucleus and the emission of the neutron. From the energy relations of this process the velocity of the neutron emitted in the forward direction may well be about  $3 \times 10^9 \text{ cm per sec}$ . The collisions of this neutron with the atoms through which it passes give rise to the recoil atoms, and the observed energies of the recoil atoms are in fair agreement with this view. Moreover, I have observed that the protons ejected from hydrogen by the radiation emitted in the opposite direction to that of the exciting  $\alpha$ -particle appear to have a much smaller range than those ejected by the forward radiation.

This again receives a simple explanation on the neutron hypothesis.

If it be supposed that the radiation consists of quanta, then the capture of the  $\alpha$ -particle by the  $\text{Be}^9$  nucleus will form a  $\text{C}^{13}$  nucleus. The mass defect of  $\text{C}^{13}$  is known with sufficient accuracy to show that the energy of the quantum emitted in this process cannot be greater than about  $14 \times 10^6 \text{ volts}$ . It is difficult to make such a quantum responsible for the effects observed.

It is to be expected that many of the effects of a neutron in passing through matter should resemble those of a quantum of high energy, and it is not easy to reach the final decision between the two hypotheses. Up to the present, all the evidence is in favour of the neutron, while the quantum hypothesis can only be upheld if the conservation of energy and momentum be relinquished at some point.

J CHADWICK

Cavendish Laboratory,  
Cambridge, Feb 17

## The Oldoway Human Skeleton

A LETTER appeared in NATURE of Oct 24, 1931, signed by Messrs Leakey, Hopwood, and Reck, in which, among other conclusions, it is stated that "there is no possible doubt that the human skeleton came from Bed No 2 and not from Bed No 4". This must be taken to mean that the skeleton is to be considered as a natural deposit in Bed No 2, which is overlaid by the later beds Nos 3 and 4, and that all consideration of human interment is ruled out.

If this be true, it is a most unusual occurrence. The skeleton, which is of modern type, with filed teeth, was found completely articulated down even to the phalanges, and in a position of extraordinary contraction. Complete mammalian skeletons of any age are, as field palaeontologists know, of great rarity. When they occur, their perfection can usually be explained as the result of sudden death and immediate covering by volcanic dust. Many of the more or less perfect skeletons which may be seen in museums have been rearticulated from bones found somewhat scattered as the result of death from floods, or in the neighbourhood of drying water-holes. We know of no case of a perfect articulated skeleton being found in company with such broken and scattered remains as appear to be abundant at Oldoway. Either the skeletons are all complete, as in the *Stenomylus* quarry at Sioux City, Nebraska, or are all scattered and broken in various degrees, as in ordinary bone beds. The probability, therefore, that the Oldoway skeleton represents an artificial burial is thus one that will occur to palaeontologists.

The skeleton was exhumed in 1913, and published photographs show that the excavation made for its disinterment was extensive. It is, therefore, very difficult to believe that in 1931 there can be reliable evidence left at the site as to the conditions under which it was deposited. If naturally deposited in Bed No 2, the skeleton is of the highest possible importance, because it would be of pre-Mousterian age, and would be in the company of *Pithecanthropus* and the Pittedown, Heidelberg, and Peking men, all of whose remains are fragmentary to the last degree. Of the few other human remains for which such antiquity is claimed, the Galley Hill skeleton and the Ipswich skeleton are, or apparently were, complete. The first of these was never seen *in situ* by any trained observer, and the latter has, we believe, been withdrawn by its discoverer. The other fragments, found long ago, are entirely without satisfactory evidence as to their mode of occurrence.



We are, therefore, forced to the conclusion that the Oldoway man reached the position in which he was found by an artificial and probably a relatively recent burial, and should be glad to hear from Messrs Leakey, Hopwood, and Reck on what grounds they have based their statement that there is no possible doubt that the human skeleton came from Bed No 2

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D M S WATSON

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### Segregation of Cementite from Austenite

THE formation of new phases in alloys by precipitation from solid solutions has recently been studied extensively<sup>1</sup>. These studies have given experimental evidence indicating that when a precipitate forms as plates within a crystalline grain, the crystallographic plane to which the plate lies parallel is determined, not only by the lattice structure of the parent solid solution, but also by the lattice structure of the precipitate.

Recently Hanemann and Schroder<sup>2</sup> have stated that the external form of the precipitate is determined only by conditions of diffusion, which, in turn, are determined only by the lattice structure of the parent solid solution. In proof of this contention, they state that  $\text{Fe}_3\text{C}$  (cementite) precipitating in alloys of iron and carbon between 0.9 and 1.7 per cent carbon from the solid solution of carbon in gamma iron (austenite) forms in plates parallel to octahedral and cube planes in the austenite, a behaviour identical with that shown by 'pure' iron (ferrite) precipitating in alloys with less carbon (0–0.9 per cent) from the same parent solid solution, though the crystal structures of the two precipitating phases are radically different.

This problem has been studied at the Naval Research Laboratory, with results different from those of Hanemann and Schroder. The analysis of the cementite structure is more difficult than that of other Widmanstätten figures. Iron-carbon alloys suffer a eutectoid inversion at  $720^\circ$ , and for this reason the matrix in which cementite plates are found embedded within each cell at room temperature is pearlite, with no residuum of the original austenite lattice. For this reason, the positions of the cementite plates cannot be directly compared with the positions of the crystallographic planes in the original austenite parallel to which the cementite plates form. Indirect methods, however, have proved useful.

A sample with 1.4 per cent carbon exhibiting several very large austenite cells—some a centimetre in diameter—and showing unusually large and well-formed cementite plates, was polished on three faces approximately at right angles in such a way that a chosen cell lay at a corner, extending well along each of the three sides. The angular positions in space taken by the individual cementite plates that could be seen to extend from one face around a  $90^\circ$  edge to another face were determined by measuring the angles formed by each separate plate trace with the edge. By a series of eight regrinding and repolishing operations, ninety-seven needles were successfully traced around an edge and measured. The angular positions in space of these plates were then plotted stereographically, as shown in Fig. 1, in which the plane of the projection is one of the polished faces, the normals to the cementite plates appearing as dots. It may be seen in this plot that the stereographic points group

themselves in three circles. Symmetry considerations suggest that these points are grouped around three mutually perpendicular axes, and an approximation of the centre of each of the circles—the approximate centres of gravity determined by intersecting stereographic great circles—should give the approxi-

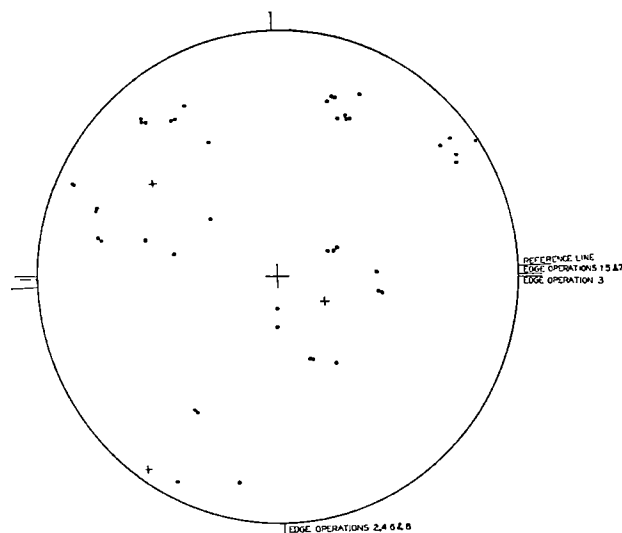


FIG 1

mate positions of these three axes. It was found that positions obtained in this way (the small crosses in Fig. 1) could be stereographically rotated into  $[100]$  directions of a standard cubic projection with surprising accuracy. Fig. 2 shows the result of this rotation, with  $[100]$  directions plotted as squares.

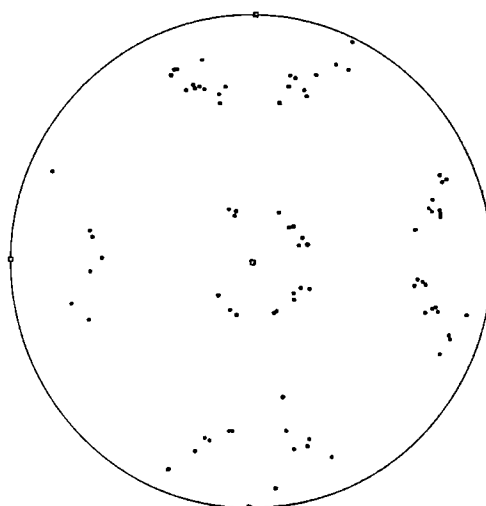


FIG 2

It seems quite certain that the  $[100]$  directions obtained in this way truly represent the  $[100]$  directions in the original austenite lattice—or equivalently, the stereographic projections of the  $(100)$  planes, cubic symmetry permits no other interpretation. The exact grouping of the projections of the cementite plates around these  $(100)$  positions, however, is difficult to interpret. A comparison with a standard projection shows that no one form of plane in the austenite lattice can explain the projections of all the cementite plates, for they scatter rather irregularly

on the circle about the (100) positions. When all the points shown in Fig 2 are stereographically rotated into one quadrant, some slight evidence of grouping centring around the projections of the (722) and (521) planes becomes evident, but this grouping is not sufficient to permit a choice of the austenite planes to which the cementite plates lie parallel.

However, it is clear that the cementite plates do not lie parallel to (111) or (100) planes, and that their positions with respect to the parent austenite lattice differ fundamentally from those taken by ferrite plates. Since both ferrite and cementite form from a common phase, austenite, it seems certain that the crystal structure of the precipitate is one of the essential factors in determining the arrangement of the precipitate plates.

Other evidence besides this may be cited, however. If, as Hanemann and Schroder suggest, the formation of Widmanstätten figures—figures of segregation—in hypo- and hyper-eutectoid iron-carbon alloys is determined only by the diffusion mechanism characteristic of interstitial solid solutions such as austenite, the Widmanstätten figure obtained in iron-nickel alloys (meteorites) in which the solid solutions are purely substitutional in type should be radically different, yet the Widmanstätten figures in hypo-eutectoid iron-carbon alloys and in meteorites are crystallographically analogous. Furthermore, if diffusion conditions alone determine the type of figure, it would be expected that all Widmanstätten figures formed by precipitation from solid solutions of one basic metal would be identical in form, yet the precipitation of the  $\gamma$ -phase from the aluminum-rich terminal solid solution in the aluminum-silver system leads to the formation of plates parallel to the (111) plane, that of the  $\text{CuAl}_2$  phase from the aluminum-rich terminal solid solution in the aluminum-copper system forms plates parallel to the (100) plane, and that of the precipitate from the aluminum-rich solid solution in the aluminum-magnesium-silicon system forms plates parallel to the (100) and (110) planes. Although doubtless diffusion conditions affect the external form of a segregate from solid solutions somewhat, it seems certain that the external form taken by the precipitate and the orientation of the lattice of the precipitate are largely determined by crystallographic relationships existing between the two participating phases.

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CHARLES S. BARRETT  
DANA W. SMITH

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Washington, D C

<sup>1</sup> R. F. Mehl and C. S. Barrett, *Trans. Amer. Inst. Min. Met. Eng., Inst. Metals Div.*, 78, 1931. R. F. Mehl and O. T. Marzke, *ibid.* p. 123. R. F. Mehl and C. S. Barrett, *Metals and Alloys*, 1, 442-443, 1930.

<sup>2</sup> H. Hanemann and O. Schroder, *Z. Metallkunde*, 23, 278, 297, 1931.

#### Beta-Rays of Radium-D

MR. H. O. W. RICHARDSON'S<sup>1</sup> most interesting investigations of the  $\beta$ -rays of radium-D induce me to make certain complementary remarks.

1. In the first place I should like to point out that the experimental results of the above-mentioned researches practically agree with the results of earlier investigations regarding the same problems. This fact is most clearly illustrated by Fig 1, which compares the results of Petrowá's<sup>2</sup> measurements (2070 measured  $\beta$ -rays) with those found by Richardson (377 measured rays).

In these diagrams the abscissæ of the maxima correspond almost exactly and the difference in the relative intensity appears to be very small, especially

if we consider Petrowá's statement that her first maximum is too low.

However, I am obliged to disagree with Richardson in the interpretation of his results. As a matter of fact, I do not agree with his supposition that the rays of 0.7 cm. ranges (in air) do not correspond with a real group of homogeneous  $\beta$ -rays. This group has not only been found by Richardson and Petrowá but also by Meitner,<sup>3</sup> and thus the existence of these rays has been proved by three different authors.

Now, if this group does really exist, it must necessarily belong to the L-electrons, as no other group of more feeble energy has been discovered in the photographs of the  $\beta$ -ray spectrum of radium-D.

If this statement proves to be exact, it is strongly opposed to some of Richardson's conclusions.

2. Hitherto it has been supposed that all the  $\beta$ -rays with ranges greater than approximately 0.7 cm.

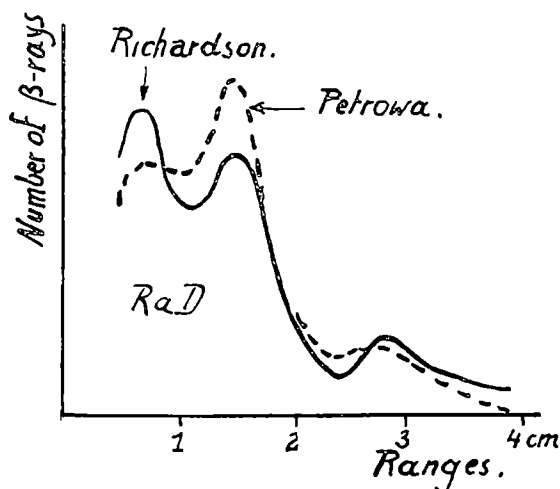


FIG 1

are of secondary origin. This opinion does not disagree with Richardson's results. If we suppose the short  $\beta$ -rays ( $R < 0.6$  cm.) to be of tertiary (or perhaps primary) origin, it follows, from the numbers given by Richardson, that every 100 decomposed atoms emit about 115 secondary  $\beta$ -rays, which result confirms—within his limit of precision (20 per cent)—my<sup>4</sup> figures, namely, 97  $\beta$ -rays per 100 atoms.

3. As to the number of gamma-rays emitted by radium-D, the work of Gray<sup>5</sup> used by Richardson as a basis for some of his calculations appears to me to have been superseded by two more recent investigations,<sup>6,7</sup> which latter give a number of quanta of 3 per cent, against 12 per cent according to Gray.

E. STAHEL.

University of Brussels,  
Dec 1931

<sup>1</sup> H. O. W. Richardson, *Proc. Roy. Soc., A*, 133, 367, 1931.

<sup>2</sup> J. Petrowá, *Z. Phys.*, 55, 628, 1929.

<sup>3</sup> L. Meitner, *Naturwiss.*, 14, 1199, 1926.

<sup>4</sup> E. Stahel, *Z. Phys.*, 68, 1, 1931.

<sup>5</sup> J. A. Gray, *Nature*, 123, 568, 1929.

<sup>6</sup> S. Bramson, *Z. Phys.*, 66, 721, 1930.

<sup>7</sup> E. Stahel and G. J. Sizoo, *Z. Phys.*, 66, 741, 1930.

We take this opportunity of replying to the criticisms expressed in Prof. Stahel's letter printed above. Prof. Stahel has investigated<sup>1</sup> the  $\beta$ -particle emission of radium-D, using a point counter as was first accomplished by Riehl.<sup>2</sup> Through a collodion window of 0.8 mm. air equivalent thickness 0.83 particles per disintegration were registered. Stahel maintains that all these particles were photoelectrons produced by the known  $\gamma$ -ray of 47.2 ekv energy. He bases this

contention (a) on Petrová's<sup>3</sup> interpretation of a range distribution constructed from Wilson chamber observations, and (b) upon certain control experiments made upon the absorption in the counter window in his own researches<sup>1</sup>

(a) As has been suggested by one of us (N F),<sup>4</sup> Petrová's interpretation of the range distribution curve is neither self-consistent nor consistent with the results of range measurements by Wilson,<sup>5</sup> Ikeuti,<sup>6</sup> and Nuttall and Williams.<sup>7</sup> It is not self-consistent, since it is surely impossible, using any reasonable range-energy relation, to assign energies 30.9, 43.3, and 47 ekv, respectively, to homogeneous  $\beta$ -particle groups having mean ranges 0.80, 1.58, and 2.9 cm in standard air, and, from the second viewpoint the discrepancy is the more serious because in the three cases cited the energies of the photoelectron groups employed were known without ambiguity from the wave-lengths of the characteristic X-rays isolated for their production. The more recent and more extensive data of Williams<sup>8</sup> substantially confirm these earlier results, so that the only evidence in line with the interpretation of Petrová is to be found in 83 radium-D  $\beta$ -particle tracks measured by Meitner.<sup>9</sup> Knowledge of the energies in this case cannot be assumed independently of the very interpretation which is in question.

(b) Stahel examined the effect of placing a second and a third thickness of collodion in the path of the beam. He found that for every 100 particles transmitted by one, 88.5 were transmitted by two, and 76.2 by three such thicknesses of material. This almost uniform absorption apparently he regarded as indicating the absence, after passing the first absorber, of particles of less energy than that of the photoelectrons of the most intense group.

The question at issue may be put to direct numerical test. We assume the relation of Nuttall and Williams,<sup>7</sup> connecting mean range and energy, and the results of Williams<sup>8</sup> concerning transmission through thin foils. The latter, obtained by detailed analysis of  $\beta$ -particle tracks in oxygen, we assume, for rough calculation, to be directly applicable to the case of collodion, and, over the range of energies in question, we regard the form of the transmission fraction curve as independent of the initial energy of the particles. Then it is found that, for a beam consisting initially of 80 secondary electrons ( $50 L_1$ ,  $20 M_1$ ,  $10 N_1$ ) together with 10 tertiary electrons ( $M_1$ ) from the  $\gamma$ -ray of 47.2 ekv energy, 85.14 electrons are transmitted through the first absorber, 6.29 are lost in the second, and 2.24 in the third. This represents an absorption of 10 per cent in the second and third absorbers, compared with 23.8 per cent observed by Stahel. If, on the other hand, a hypothetical beam be taken such that 50 photoelectrons, secondary and tertiary, due to the above  $\gamma$ -ray, with 50 additional electrons of 12.5 ekv energy, pass through a single thickness of absorber, a parallel calculation gives its intensity, after passage through two or three such absorbers, as 88.8 or 76.0 electrons, respectively. The "additional" electrons here postulated are in the form of a group of single energy for ease in calculation only, the low value of energy assigned to them is intended merely to suggest a continuous distribution extending to very low energies. Taken together, these two calculations provide evidence against the conclusion which Stahel has drawn, but, being intended solely as illustrating the possibilities of the case, they must not be regarded as capable of yielding a solution on the evidence at hand.

The problem of the primary  $\beta$ -particle emission of radium-D, it must be admitted, is still far from a complete solution, but we hold, and our reasons

appear above, first, that in the experiments of Stahel, electrons other than those comprising the known photoelectron groups were counted, and, secondly, that the identification of these groups in the range distribution curves of Petrová is a mistaken one.

N FEATHER

Trinity College, Cambridge

H O W RICHARDSON

King's College, London

Jan 18

<sup>1</sup> *Z. Phys.*, **68**, 1, 1931

<sup>2</sup> *Z. Phys.*, **46**, 478, 1927

<sup>3</sup> *Z. Phys.*, **55**, 628, 1929

<sup>4</sup> *Proc. Camb. Phil. Soc.*, **25**, 522, 1929

<sup>5</sup> *Proc. Roy. Soc. A*, **104**, 192, 1923

<sup>6</sup> *C. R. Acad. Sci.*, **180**, 1257, 1925

<sup>7</sup> *Phil. Mag.*, **2**, 1109, 1926

<sup>8</sup> *Proc. Roy. Soc. A*, **130**, 310, 1931

<sup>9</sup> *Naturwiss.*, **14**, 1109, 1926

### Intensity Ratio of Fluorescent X-Ray Lines

In the course of his extensive investigations on the magnetic spectra of X-ray electrons, H. Robinson found<sup>1</sup> that the ratio of the numbers of electrons emitted from different levels of an atom is dependent upon the frequency of the exciting radiation. It was to be expected that the same dependency would be met in the behaviour of secondary X-ray lines emitted by different levels of the same atom. This expectation has already been verified qualitatively in the case of the cerium  $L$  lines by Skinner.<sup>2</sup>

In view of the importance of this effect for chemical analysis by secondary X-rays and also for different theoretical problems, we have measured the intensity ratio of silver  $L\beta_2$  and silver  $L\beta_3$  lines excited once with an effective wave-length of 2.6 Å and then with 1.3 Å. As is shown below, the variation in the wave-lengths of the exciting radiation influences the intensity ratio of the two silver lines to a very large extent.

| Effective Wave-Length in Å | Intensity Ratio of Silver $L\beta_2$ and Silver $L\beta_3$ | Change in Intensity Ratio of the two Lines |
|----------------------------|------------------------------------------------------------|--------------------------------------------|
| 2.6                        | 100 25                                                     | 1 2.4                                      |
| 1.3                        | 100 60                                                     |                                            |

From this result it follows that in chemical analysis, when exciting secondary lines with continuous radiation, we have to apply the same voltage at which the intensity ratio of the standard and the line in question was determined. Points of theoretical interest in connexion with the above results will be discussed in a detailed paper, one of these points being that the fluorescent yield of the total radiation emitted by the excited atom is dependent upon the exciting radiation.

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<sup>1</sup> *Proc. Roy. Soc. A*, **104**, 445, 1923

<sup>2</sup> *Proc. Camb. Phil. Soc.*, **22**, 379, 1925

### Determinism

IN his address on the decline of determinism,<sup>1</sup> Sir Arthur Eddington enunciates a very curious equation: "If the atom has indeterminacy, surely the human mind will have equal indeterminacy for we can scarcely accept a theory which makes out the mind to be more mechanistic than the atom." This statement will not bear too close an examination even from a non-quantitative point of view. Thus an attempt by myself to solve even a simple wave equation might lead to any of a large number of

results, a similar attempt by Sir Arthur Eddington would lead to the correct solution with a high degree of probability. I do not think that this proves that his mind is more mechanistic than my own, whatever that may mean. Actually it is generally regarded as a compliment to describe a person as reliable, that is, to suggest that his conduct is predictable.

Fortunately, however, quantitative data exist which seem to show that, as regards moral behaviour, some minds are decidedly more determined than are some atoms as regards radiative behaviour. Consider a given man  $M_1$ , and the probability  $p$  that between times  $T_1$  and  $T_2$  he will commit an action such as to lead to his imprisonment for a breach of the law. If we have no further information regarding  $M_1$ ,  $p$  is in most communities a small number, less than 0.01. If, however,  $M_1$  has a monozygotic twin  $M_2$ , brought up in the same environment up to the age of 14, and  $M_2$  is known to have been imprisoned for crime between the ages of 16 and 40, we can infer with a fairly high degree of probability that  $M_1$ , who has an identical nature and a similar nurture, has been or will be imprisoned between the same ages. Judging from Lange's<sup>2</sup> results,  $p$  is about 0.875 in south Germany when we have the above amount of information. If we increase the amount of information, for example, by excluding cases where  $M_2$  has suffered from head injury, the value of  $p$  is raised still further. Now, if it could be shown that with sufficient information  $p$  became unity in a case of this kind, we should, I take it, have proved the determinacy of some kinds, at least, of moral choice. Actually the most that scientific method can do is to prove  $p > 1 - \epsilon$ . If Sir Arthur Eddington is correct, then no matter how complete our information,  $\epsilon$  tends to a finite limit which is not very small. Clearly no amount of observation could prove it to be zero. But if it could be shown to be less than 0.01, we could neglect it to a first approximation in ethical theory, and if it proved to be less than  $10^{-6}$  we might hazard the guess that the behaviour of human beings showed no more indeterminacy than that of other systems composed of about  $2 \times 10^{27}$  atoms.

I think that it is a legitimate extrapolation from the existing data that if we used all the available data in the above case,  $\epsilon$  would be less than 0.05. It seems unfortunate that any attempt should be made to prejudge, on philosophical or emotional grounds, the magnitude of a quantity susceptible of scientific measurement. But from the heuristic point of view the deterministic theory has the advantage that it could be disproved, and would be if  $\epsilon$  tended to a finite limit as the amount of available information increased indefinitely. On the other hand, indeterminism cannot be disproved unless its supporters state the value of  $\epsilon$ , which they have so far carefully avoided. When the truth about human behaviour is discovered, it will probably appear that philosophers of all schools had failed to predict it as completely as they failed to predict Heisenberg's uncertainty principle. Human behaviour is a subject for scientific investigation rather than *a priori* pronouncements.

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<sup>1</sup> NATURE, 129, 240, Feb. 13, 1932.  
<sup>2</sup> "Crime as Destiny", 1931.

Is it really necessary to appeal to anything so *recherché* as Heisenberg's Principle of Indeterminacy in order to justify anything so familiar as personal freedom of choice? This question arises on reading Sir Arthur Eddington's interesting address in NATURE of Feb. 13. Consider any one of the laws of physics

commonly verified in the laboratory, say  $T = 2\pi\sqrt{l/g}$  for a simple pendulum. If, while one student is observing the pendulum, another student were to knock it about, the observations might misfit the formula. And so in general the accepted laws of physics are verified only if no person interferes with the apparatus. We cannot interfere with the moon, because it is so massive and so far away and that is part of the reason why the motion of the moon is almost deterministic, the 'almost' referring to the extremely small Heisenbergian indeterminacy. But there is no great mass or great distance to prevent John Doe interfering with his own brain in the act of making his decision to buy a house from Richard Roe.

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Feb. 13

### Catalysis in an Inert Solvent

It is becoming increasingly clear that carbon tetrachloride is an ideal solvent in the sense that it allows reactions of varying kinetic type to proceed in it at the same rate as they do in the gaseous phase.<sup>1</sup> This lends great interest to the results of Lowry and Traill<sup>2</sup> on the kinetics of the mutarotation of beryllium benzoylcamphor in this solvent. The reaction in pure carbon tetrachloride is very slow, but when catalysed by pyridine or ethyl alcohol, unimolecular constants are obtained which are proportional to the concentration of the catalyst.

The change is thus essentially bimolecular, and its rate must depend on the number of encounters between molecules of catalyst and of beryllium benzoylcamphor. Assuming the reactant molecule to be activated by the kinetic energy of the colliding molecules, it becomes possible to calculate the energy of activation according to the method of Lewis<sup>3</sup>

$$\frac{\text{Number of molecules reacting}}{\text{Total number of collisions}} = e^{E/RT}$$

By applying the gas formula to calculate the number of collisions,<sup>4</sup> taking the sum of the molecular radii as  $7 \times 10^{-8}$  cm, and  $T = 298^\circ$ , we find the values of  $E$  given below. These agree within the limit of measurable uncertainty with the experimental values found by plotting  $\ln k$  against  $1/T$ .

| Catalyst | $E$ (calculated) | $E$ (observed) |
|----------|------------------|----------------|
| Pyridine | 18,840           | 18,850         |
| Alcohol  | 18,410           | 18,690         |

Unless the agreement is accidental—and on the whole this seems most unlikely—the following points emerge. (1) The gas collision formula can be used to determine the number of collisions between two species of solute molecules present at low concentrations in an inert solvent. (2) Another example has been revealed of a reaction proceeding in solution at the same rate as theory would predict it to have in the gaseous phase. Deactivations by solvent molecules thus appear to be absent. (3) Lowry and Traill have succeeded, by the suitable choice of reactant, solvent, and catalysts, in examining a reaction which has all the characteristics of the simplest conceivable case of catalysis in solution.

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Jan. 27

<sup>1</sup> Moelwyn-Hughes and Hinshelwood, *Proc. Roy. Soc. A*, **131**, 177, 1931.

<sup>2</sup> Lowry and Traill, *ibid.*, **A**, **132**, 398, 1931.

<sup>3</sup> Lewis, *Trans. Chem. Soc.*, **113**, 471, 1918.

<sup>4</sup> Jeans, "The Dynamical Theory of Gases", p. 259, 1925.



## Ancient Windmills

ACCOMPANYING this note are two windmill illustrations (Figs. 1 and 2), one from Ramelli's "Le diverse et artificiose Machine", 1588 (Brit. Mus., 48, f. 15), and the other from the great Chinese Encyclopædia or "Ch'in Ting Ku Chin T'u Shu Chi Ch'eng", vol. 32,



FIG. 1.—Windmill in Ramelli's "Le diverse et artificiose Machine" (1588)

sec. 245 (Brit. Mus., Oriental students' room). For the benefit of readers of NATURE who may not be familiar with the Chinese Encyclopædia, I may say that the only complete copy of the first edition out-

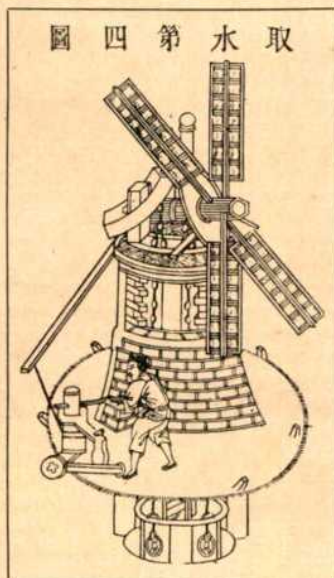


FIG. 2.—Windmill in the Chinese Encyclopædia

side China is in the British Museum, consisting of 750 bulky volumes fully illustrated, and that the work was completed about two hundred years ago.

The illustrations will be of interest to students of technological history, as they appear to indicate that the Chinese encyclopædist had access to European sources and made use of them when compiling this work. I may say that I have found European counterparts of other illustrations in the Encyclopædia, a

number of horizontal windmill illustrations apparently having been copied with very slight modification from the "Machinae Novae Fausti Verantii" (Brit. Mus., 535, i. 16), published at Venice about 1692, and illustrations of sawmills, etc., from various European works of the sixteenth and seventeenth centuries. The most probable explanation seems to be that copies of these works were taken to China by Jesuit missionaries—Athanasius Kircher, for example.

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## Heat of Dissociation of Oxygen

THE heat of dissociation of oxygen has given rise to some lively controversies in recent years. Mecke<sup>1</sup> concluded from the photochemical work of Norrish on NO<sub>2</sub> that  $D_{O_2} = 128$  kcal., a view which was supported by V. Henri<sup>2</sup> from the interpretation of the predissociation spectra of NO<sub>2</sub> and SO<sub>2</sub>. Birge and Sponer,<sup>3</sup> on the other hand, conclude, from the analysis of the Runge-Schumann bands, that the heat of dissociation in the excited state amounts to 162 kcal. Herzberg<sup>4</sup> was of opinion that the molecule in the excited state was made up of a (<sup>3</sup>P) oxygen atom and a (<sup>1</sup>D<sub>2</sub>) atom, hence subtracting from Birge's figures the heat of excitation to the <sup>1</sup>D<sub>2</sub> state, namely, 45 kcal., he gets the heat of dissociation of O<sub>2</sub> into two <sup>3</sup>P atoms as 117 kcal. This view seems to have been accepted by Franck, though Copeland<sup>5</sup> supports Mecke's value of 128 kcal. from his study of the heat of formation of the molecule from the atomised state in the discharge tube.

I have found that SO<sub>3</sub> vapour, in contrast with SO<sub>2</sub> vapour, which gives a band absorption, shows a continuous absorption with a long wave-length limit at  $\lambda 3300$ , corresponding to 86.7 kcal. From this data, assuming the reaction due to light to be given by  $SO_3 + 86.7 = SO_2 + O$  (atomic), I have calculated the heat of dissociation of oxygen with the aid of thermochemical data<sup>6</sup> for the heats of formation of SO<sub>2</sub> and SO<sub>3</sub>. The thermochemical relations are

$$(SO_2) + 69.3 = [S] + (O_2) \\ \text{and } (SO_3) + 91.9 = [S] + \frac{3}{2}(O_2).$$

This gives with the above relation the value of  $D_{O_2}$  as 128 kcal. The value is thus in agreement with the results of Mecke, Henri, and Copeland and does not agree with that given by Herzberg.

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Jan. 13.

<sup>1</sup> Mecke, *Naturwiss.*, **17**, 996; 1929.

<sup>2</sup> Henri, *NATURE*, **125**, 202, 275; 1930.

<sup>3</sup> Birge and Sponer, *Phys. Rev.*, **28**, 259; 1926.

<sup>4</sup> Herzberg, *Z. phys. Chem.*, B, **4**, 223; 1929; **10**, 189; 1930.

<sup>5</sup> Copeland, *Phys. Rev.*, **36**, 1221; 1930.

<sup>6</sup> "Landolt-Börnstein's Tables", p. 1494, 1923 edition.

## A Symbol of the Space-Time Continuum

If a strip of stamp edging is taken, given a half twist, and the ends joined, we have formed one of the well-known paradromic rings, having only one surface and one edge.

The figure occupies three dimensions in space, but like time has the feature of endlessness, or like Einstein's finite space returns on itself. I suggest, therefore, that it may well stand for a symbol of the space-time continuum.

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## Research Items

**Yuma Ethnography.**—A report on the results of two visits of ethnographical investigation among the Yuma Indians in 1928 and 1929 by Prof. C. Daryll Forde is published as vol. 28, No. 4, of the University of California's *Publications in American Archaeology and Ethnology*. The Yuma now occupy a reservation on the west bank of the Colorado River at the confluence of the Gila, which includes the greater part of the land which they occupied at the time of Spanish exploration. They have, therefore, suffered little disturbance; but owing to their assimilation of American culture, the material culture—basket-making, weaving and pottery-making—has disappeared, and so to a great extent has their social organisation. Their sense of tribal solidarity, however, is strong. Formerly they lived in scattered settlements near their patches of arable land and mesquite bushes. The men went naked, while the women wore a two-piece bark skirt. They resemble the other Indians of Colorado in their great stature. The people were agriculturists, depending upon the natural irrigation of the river overflow. They cultivated corn, beans, pumpkins, melons, and grasses. As a result of an intensive study of social organisation and ritual, it is concluded that the culture of the Yuma and other tribes of the Lower Colorado is remarkable in its divergence from that of the Pueblos and the Californians. Nor are they transitional groups. Although there are signs of fusion of south-western and Californian cultural traits, there are other elements which are strikingly individual. Thus, though they divide themselves into exogamous groups, these groups are patrilineal. Among the markedly individual traits is the subordination of wealth, hereditary right and ability, to the acquisition of supernatural power.

**The Buffalo-Fly Danger in Australia.**—The buffalo-fly (*Lyperosia exigua*) is not a native of Australia, but is supposed to have been introduced from the Indo-Malayan region with buffaloes imported by way of Melville Island, so early as 1825 (R. J. Tillyard, *J. Coun. Sci. Indust. Res.*, Australia, 4, 234; 1931). With the development of the pastoral industry in northern Australia, the fly began to take its place as an economic factor; for although it does not carry disease and does not kill its host, it sucks its blood and produces serious loss of condition due to 'fly-worry'. The point when toleration is replaced by nervous strain is represented by a concentration of about a thousand flies to each beast. The creatures attacked in Australia belong to a wider range than the hosts in the Netherland Indies, and include buffaloes, cattle of all kinds, horses, mules, donkeys, and occasionally man himself; but the serious aspect of the problem is that the fly shows yearly a wider range of distribution, having moved with cattle herds until it has spread over all the settled portions of the Northern Territory north of the 20-inch rainfall line. By 1910 it had reached Kimberley, and has become the worst cattle pest there. Beyond this northern range it is unlikely to pass by natural extension, because of the barrier of a dry belt, but there is great danger that it may be transported to south-western Australia through the uncontrolled importation of cattle from Derby to Fremantle, where the fly did appear in 1928 but was eradicated. Efforts are to be made by the introduction of parasitic insects so to reduce the numbers of adult buffalo-flies that they fall below the level which causes economic loss.

**Distribution, Ecology, and Classification of Tunicata.**—Dr. Harold Thompson has continued his study of

the distribution, ecology, and classification of the Tunicata of the Scottish area (Fisheries Board for Scotland, *Sci. Invest.*, 1931, No. 1, "The Tunicata of the Scottish Area. Part 2, The Styelids and Botryllids of the order Ptychobranchia"). The importance of physical environment in determining the distribution of the various species is stressed, and a list of records, with a chart showing the distribution, is appended to the description of the morphological characters of each species. The typical arctic, boreo-arctic, boreal, and south boreal forms are listed, with notes of the limiting conditions of temperature and depth of each type. Dr. Thompson maintains temporarily the separation of the Botryllidæ and Styelidæ until further investigations have been carried out on the methods of budding of the two families. The genus *Kuken-thalia*, whilst having obvious affinities with the other genera of the family Styelidæ, appears to possess a brood pouch of similar origin to that of the genus *Botrylloides*, and when the nature of the affinities has been fully disclosed it is probable that the Botryllidæ will have to be subordinated as a subfamily of the family Polyzoidæ, which Hartmeyer includes with the styelids. A single species of *Botryllus*—*B. schlosseri* Pallas—is retained, the old *Botryllus aureus* being regarded as a species of *Botrylloides*, with which genus it agrees in the nature of the systems, presence of brood pouches, shape of testes, and position of vasa deferentia.

**Zoning of Amphipod Species.**—Mr. Richard Elmhirst, director of the Scottish Marine Station at Millport, in a paper entitled "Studies in the Scottish Marine Fauna.—The Crustacea of the Sandy and Muddy Areas of the Tidal Zone" (*Proc. Roy. Soc. Edinburgh*, Session 1930-31, volume 51, part 2 (No. 21)), shows that a rich intertidal amphipodan fauna in certain areas of the Clyde, notably Cumbrae, exhibits zoning by species. *Bathyporeia guilliamsoniana* is the dominant low water form in the clean sand, beginning about low tide level and extending seawards to about four fathoms, with a definite maximum about low water. In Loch Gilp it suddenly disappears at about one fathom. *Corophium volutator* in the muddy brackish area of the high water region is very abundant, taking the place of *Corophium crassicornis*, which is the typical low water mark species. *Haustorius arenarius* is usually confined to the upper half of the intertidal area, preferring rather loose sands which often occur high up on the beach as a result of wind and wave action. The distribution of this species coincides with that of the annelid *Nerine foliosa*.

**Chromosome Linkage in Garden Peas.**—When a Tibetan variety of the cultivated pea (probably brought back by the Mt. Everest Expedition) is crossed with the English variety, Duke of Albany, there is full fertility except when a particular 'line' of the Tibetan pea is used. This line was shown to produce hybrids with a ring of four chromosomes and semi-sterility, half the gametes failing to mature. A further genetical and cytological study of these forms has been made by Caroline Pellew and Mrs. E. Sansome (*J. Genetics*, vol. 25, No. 1). Two other cases of ring formation, accompanied by linkage of factors which are normally independently inherited have been discovered in Swedish varieties of peas by Hammarlund and Håkansson. The chromosome carrying the factors for round and wrinkled cotyledon are in the chromosome ring in the Tibetan variety, the plants heterozygous for these factors being usually semi-sterile, but there are about one in eight



exceptions in each class. The fertile sister plants have seven bivalents. A cytological study of chiasma formation in the meiotic chromosomes shows that the results are in accordance with Belling's hypothesis of segmental interchange. The ring of four on the heterotypic spindle separates so that adjacent chromosomes go to the same pole, or in other words, double non-disjunction takes place, in about half the cases observed. It is suggested that this gives rise to the non-viable gametes, as such gametes will show genic unbalance, having two members of one pair of chromosomes and lacking both members of another pair.

**Timber Pit Props**—Apart from other dangers, the safety of the men working in coal mines is to a considerable extent dependent upon the strength of the pit props supporting the galleries. That this matter is one of primary importance becomes evident when it is remembered that timber is a very variable material. Work which has been carried out in this matter has been recently published in a brochure entitled "Tests on Timber Pit Props", by S. M. Dixon and M. A. Hogan (Safety in Mines Research Board, Paper No. 72, London: H. M. Stationery Office, 2s. net). In these tests the writers say "In one most variable batch of props the strength of the weakest prop was less than half the average strength and only about a quarter the strength of the strongest prop, though all the props were nominally similar." It is pointed out, a factor not always realised, that round untapered props are very rigid and comparable to rigid steel props. They therefore do not show an appreciable amount of shortening or 'give' before failure, and consequently are dangerous. To ensure the maximum 'give', which would render the approaching failure evident to the trained eye, it is suggested that the diameter of the small end of the taper should be half the diameter of the prop. These tests have covered a wide range and data have been obtained as to the average strengths of round props of home-grown and imported timber of various species, the average strengths of quartered and tapered props, the extent and nature of the shortening under load of untapered props and props with tapers of various forms, the effects of the rate of loading, repeated loading, and sustained loading, the effects of the moisture content of the timber, and the variations with time in the moisture content of props stacked in the open and under cover.

**Jurassic History of North America**—One of the most detailed palaeogeographical studies yet made, accompanied by fourteen maps of North America from the beginning of the Jurassic to the early Cretaceous, has been published by C. H. Crickmay (*Proc. Amer. Phil. Soc.*, Philadelphia, pp. 15-102, 1931). Each map represents the geography of a closely defined date, and the series is adequate to illustrate the culminations of all the notable geological events of the period. The results bring out the fact that there were four main marine transgressions: Liassic, Bajocian, Callovian, and Argovian. These seem also to have been world-wide transgressions, for they are represented in Europe and India. In North America the general surface was low and flat, and a comparatively slight down-warping would then cause wide marine expansion. Volcanic activity broke out vigorously in the Sonmian, in the later Middle Jurassic, and in the late Callovian, in each case in the extreme west from Alaska to California. Tectonic mountains (Agassiz orogeny) were built after the cessation of volcanic activity. The period ends with the more important Nevadan mountain building. North America was then mainly land with two areas of dominant continental sedimentation.

**Hawaiian Earthquakes, 1929-30**—A review of the remarkable series of earthquakes in these two years is given in the *Volcano Letter* issued by the Hawaiian Volcano Observatory for Nov. 5, 1931 (see also *NATURE*, 124, 851, Nov. 30, 1929). The total number of shocks recorded was 1516 in 1929 and 1070 in 1930. The large number in the former year was mainly due to the continued activity of a centre near the volcano Hualalai in the north-west of Hawaii, the numbers registered during the three weeks ending on Oct. 16 and Nov. 13 being 594 and 215 respectively. After the latter date their frequency declined, though, until the middle of March 1930, many tremors originated in the Hualalai centre. During the remainder of 1930 the seismicity of the island became normal, with a frequency of nearly a hundred shocks and tremors per month. It is suggested that the activity of the Hualalai centre was due to "lava flowing in under the volcano with an upward pressure, splitting open deep rifts, and preparing for eventual outflow somewhere to the north of the Mauna Loa centre."

**High Speed Ions**—The first December number of the *Physical Review* contains an article by D. H. Sloan and E. O. Lawrence, of the University of California, describing a method for producing very fast heavy ions (see also *NATURE*, July 11, 1931, p. 83). This does not call for unduly high voltages or elaborate apparatus, the desired acceleration of the ions being obtained by repeated application of a relatively small impulse. The ions, which are conveniently drawn from a low-voltage arc, travel through a series of metal tubes in synchronism with an oscillatory electric field applied alternately to the tubes in such a way as always to accelerate the ions passing from one tube to another. Using thirty such steps and a high-frequency potential difference of 42,000 volts at a wave-length of 30 metres, a current of  $10^{-7}$  amp of 1,260,000 volt singly charged mercury ions has been produced. The success of the method depends on the focusing and synchronisation of the beam of ions in the accelerating system, but it is apparently not difficult to effect this. The authors of the paper express the opinion that the production of 10,000,000 volt ions is an entirely practicable matter. The method is less readily applicable to light ions or electrons, on account of the great length of the apparatus needed for these.

**Electrical Protective Devices**—In the early days of electricity supply, the effects of dangerous currents were guarded against by using fuses in series with the circuit to be protected. This system proved quite satisfactory so long as the voltage was low and the power transmitted was small, but with high voltages the circuits need to be broken under oil. These oil circuit breakers are practically always of the automatic type. They are equipped with 'trip' coils or relays which, on the occurrence of abnormal conditions in the main circuit, release the energy stored in strong springs, and so the contacts separate in a small fraction of a second. In a paper read by C. L. Lipman to the Institution of Electrical Engineers on Jan. 8, improvements in the design of these relays are discussed. The advent of the national grid in Great Britain marks a new era in the history of British engineering, and particularly in the development of protective gear. The relays discussed are divided into classes. The first class includes those which prevent overload, the second prevents current leaking to earth, and the third prevents the current from running in the wrong direction. In the last case the relay prevents the generator acting as a motor and absorbing power from, instead of giving power to, a network. Mr. Lipman described a new relay which is very simple and trustworthy, and is

suitable for modern high power and high voltage circuits. Several hundreds of these devices have been in operation at places all over the world for five years and have given satisfactory service.

**Adsorption**—As is well known, Langmuir has advanced the theory that adsorption of gases on surfaces normally proceeds with the formation of a unimolecular film, and there is experimental evidence for the validity of this assumption. The most direct type of experiment involves the use of a crystal face as a plane adsorbing surface, and Bawn (*J Amer Chem Soc*, Jan) has described some measurements of the adsorption of some gases and of acetone vapour on cleavage plates of mica, which show that Langmuir's adsorption equation is closely followed in the cases of carbon monoxide and oxygen, a saturation value being reached which corresponds with one-third of the surface covered in the case of acetone. In no case was the film thicker than unimolecular, no evidence for capillary condensation being found for pressures up to one-thousandth of the saturation pressure. In the case of argon, no simple equation expresses the results. The pressures used in all the experiments were small and the temperatures low. The magnitude of the adsorption was found to be dependent upon the conditions of outgassing of the surface, which is explained on the basis of the concept of the activation energy for adsorption processes.

**Reaction Velocity**—Harned and Samaras (*J Amer Chem Soc*, Jan) have determined the velocity

of hydrolysis of ethyl orthoformate to ethyl formate in presence of a constant acidity maintained by an acetic acid-sodium acetate buffer in various solvents. The results show that, with the exception of the glycine solutions, all the other series of measurements in aqueous solutions of methyl, ethyl, *n*-propyl, isopropyl, and *n*-butyl alcohols, acetone, glycerin, and glycine show the following dependence of the velocity constant on the dielectric constant  $\ln k_0 - \ln k = 0.07(D_1 - D)$ , where  $k_0, k$  are the velocity constants in water and the mixed solvent, and  $D_1, D$  the dielectric constants of the latter, respectively. In a theoretical paper, the same authors attempt to show that the kinetic factor for medium effects can be expressed in the form  $e^{-W/RT}$  and to interpret  $W$  on the basis of electrostatics. They point out that the general problem is difficult, and confine their discussion to some important special cases. They start with a consideration of the energy change involved in the transfer of an ion from one medium to another of different dielectric constant, and with certain simplifications obtain an expression for the ratio of the activity coefficients in terms of the difference of dielectric constants. By introducing Huckel's equation for the activity coefficient of an electrolyte, they show in a number of cases that experimental results can be interpreted in terms of their theory, and conclude that the dielectric constant variation from solvent to solvent is the factor of greatest importance in causing changes in the velocity constant.

### Astronomical Topics

**Astronomical Notes for March**—The spring equinox occurs at 7<sup>h</sup> 50<sup>m</sup> P.M. on March 20. Full moon occurs on March 22, only 1½ days after the equinox, thus explaining the early Easter.

Mercury is well placed as an evening star during this month. It should be looked for low in the west in the later part of twilight. Venus may be used as a guide to it. The following table gives the difference of R.A. and Declination of the two planets.

|         | Mercury West                  | Mercury South |
|---------|-------------------------------|---------------|
| March 7 | 2 <sup>h</sup> 0 <sup>m</sup> | 14 2°         |
| 12      | 1 48                          | 12 0          |
| 17      | 1 40                          | 9 8           |
| 22      | 1 38                          | 8 3           |
| 27      | 1 45                          | 7 8           |

The magnitude of Mercury is -1.3 on March 7, +0.3 on March 27. It is at its greatest elongation, 19° from the sun, on March 23. Venus is drawing away from the sun, and becoming brighter. It reaches elongation on April 19. The illuminated portion of the disc is 0.73 on March 1 and 0.61 on March 31. The magnitude changes from -3.6 to -3.8.

Jupiter and Neptune passed opposition in February, and are still well placed for observation. There is an eclipse of Jupiter IV on March 14. It disappears at 7<sup>h</sup> 41<sup>m</sup> P.M., reappearing 35 minutes after midnight. III is also occulted and eclipsed from 8<sup>h</sup> 7<sup>m</sup> P.M. on March 14 until 3<sup>h</sup> 5<sup>m</sup> A.M. on March 15. Satellite I is occulted by IV at 11<sup>h</sup> 59<sup>m</sup> P.M. on March 5, III by IV at 2<sup>h</sup> 33<sup>m</sup> A.M. on March 7. There is an interesting double occultation of IV by I at 7<sup>h</sup> 23<sup>m</sup> P.M. on March 14 and 4<sup>h</sup> 40<sup>m</sup> A.M. on March 15. See the British Astronomical Association Handbook for 1932 for a complete list of these phenomena.

There is an annular eclipse of the sun on March 7, and an almost total eclipse of the moon on March 22. Both are invisible in Europe. The track of annularity in the former includes southern Tasmania shortly before sunset.

Only two occultations by the moon are visible during March in London, 38 B Aurigae (mag 6.5) disappears at 9<sup>h</sup> 55<sup>m</sup> P.M. on March 14,  $\tau$  Scorpi (mag 2.8) reappears at 3<sup>h</sup> 41<sup>m</sup> A.M. on March 27, at angle 262° (near the west point of the disc).

A minimum of Algol at a convenient hour occurs on March 10 at 9<sup>h</sup> 43<sup>m</sup> P.M.

The zodiacal light may be looked for at the end of evening twilight on dates when the moon is absent at that hour. It follows, approximately, the direction of the ecliptic, which is roughly determined by drawing a line from Venus to a point between the Pleiades and Aldebaran.

Search for the periodic comet Grigg-Skjellerup (which is due at perihelion on May 18) may be begun in March, as it is likely to be faint in March, the ephemeris is not given here (see the British Astronomical Association Handbook, 1932).

**New Solar Observatory of the Smithsonian Institution**—A *Bulletin* from the Smithsonian Institution, dated Feb. 1, announces that the solar observatory on Mt. Brukkaros, in South-West Africa, has been abandoned after a trial of five years, its drawbacks were haze and high winds. Several other mountains in South Africa were tried, also the Cape Verde Islands. Trial is to be made of Mt. St. Catherine, in the Sma. Range, 8540 ft. high. It is stated that the region is practically waterless and barren, and that the winds are light and come more frequently from the Mediterranean than from the desert, so that there should not be much dust.

The famous monastery of St. Catherine, where many valuable manuscripts were found, is not on this peak, but on the Jebel-Musa, some twelve miles distant. So much trouble has been taken by Dr. C. G. Abbot and his assistants in finding a suitable site, that it is to be hoped that their patience may at last be rewarded.

## Block-Movements in the Boso Peninsula (Japan)

PROF N MIYABE has recently published two remarkable papers on the movements of crust-blocks (*Earthq Res Inst Bull*, vol 9, pp 256-272, 407-422, 1931). It is clear that if a crust-block is tilted as a whole, there must exist a simple geometrical relation between the amounts of tilting in two different directions. Conversely, if this relation is satisfied by the tilts along neighbouring pairs of lines, Prof Miyabe regards the lines as lying on the same block. The papers are concerned with the crust-blocks of the Boso peninsula on the east side of Sagami Bay. The first survey of the district was made in 1898, the line of levelling being near the coast. It was repeated in 1924, shortly after the great earthquake of Sept 1, 1923, and again in 1931, and the two papers refer to the displacements that occurred during the intervals between the surveys.

In the accompanying map (Fig 1), the dotted lines represent the probable boundaries of the crust-blocks and the arrows denote the magnitudes and directions of tilting of the different blocks. The boundaries were drawn without any reference to geological maps, but several of them were found to coincide approximately with discontinuities in geological structure. These are shown as continuous lines. One of them is a well-marked tectonic line to the north of Kamogawa, and it will be noticed how different are the directions of tilting of the blocks to the north and south of this line.

The figures on the map denote the mean uplift of each block in inches between 1898 and 1924. It will be seen that there are three groups of blocks, in each of which the uplifts are approximately the same. In the south-west corner of the peninsula, they lie, as a rule, between 47 in and 51 in, with two exceptional amounts of 55 in and 61 in. To the north and east of this lies a group in which the uplift is confined between 23 in and 31 in, and, still farther, a third group in which the movements are between 8 in and 12 in, with two exceptions of 18 in and 22 in.

In the second paper, the changes of level that occurred between 1924 and 1931 are compared with those of the earlier interval. The curves representing

them show that, on the whole, the vertical movement was reversed. For example, a block elevated by 45 in in the first interval was depressed by nearly 4 in in the second. Though the constituent blocks

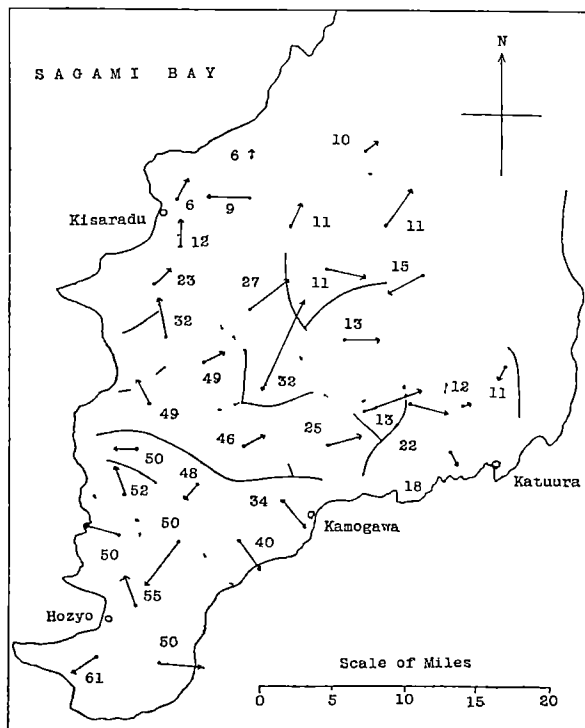


FIG 1

show a certain independence of movement, it would seem that the Boso peninsula underwent a general tilting towards the north-east in the first interval, and a return tilting towards the south-west in the second.

C D

## Preservation of Italian Folklore

IN Italy under the Fascist government every encouragement has been given to movements which quicken national self-consciousness. Those who value tradition, whether for sentimental or for scientific reasons, will applaud the efforts of the Opera Nazionale Dopolavoro (The Workers' Leisure Hours Institute) to preserve the festivals, music, and dancing of the folk, which are endangered by the industrial development of the country. Now that Russia no longer pays heed to her saints, no country in Europe is so rich as Italy in festivals, and nowhere have they been celebrated with more ritual and greater enthusiasm. It would have been a calamity had they been allowed to lapse. This probably would have been the fate of many, had it not been for the 'Dopolavoro'. Their continued existence now seems assured.

An excellent account of the work of the Institute in this field, for which the president, S. Enrico Beretta, is responsible, has been published recently\*. The first section of the book, however, is devoted to a list of

the feste which are observed in the various towns and districts of Italy. They are arranged calendrically, and brief descriptions of the essential features are given in each case. Many are illustrated by excellent photographs.

The feste are usually observed on the feast-day of the patron saint of the district, or on some festival of the Church, but pagan affinities are generally fairly easy to detect. The central feature is normally a procession, in which the image of the saint is carried round the district in a cart or on a platform. Sometimes the cart is buried in flowers, sometimes the place of the saint and cart is taken by obelisks or gigantic towers, such as the *Ceri* of Gubbio or the *Gigli* of Nolo (Naples). It is a reasonable conclusion that in ancient days the gods were carried along these same ways to purify the lands and secure the fertility of the fields of their votaries. At Easter the *Scoppio del Carro* of Florence betrays clearly the purpose of the rite. A mechanical dove released from the High Altar ignites the squibs set around the *carro* as it stands before the cathedral. A successful explosion is hailed as a sure index of abundance in the coming

\* "Costumi, musica, danze e feste popolari italiane." Pp 218. Roma: Editore Opera Nazionale Dopolavoro, 1931. 10 lire.

harvest An almost identical ceremonial opens the fire festival in one of the Pardons of Brittany The Carnival even more surely points to its pagan origin in the celebrations described

The success of the Institute in stimulating and renewing popular interest in the *feste* has been much assisted by the revival of the competitions for dialect songs, of which several are quoted These are sung during the festivals Local dances and local music played on the people's instruments, such as the pipes and bagpipes of the Abruzzi, have been encouraged A great impetus was given to interest in the preservation of local costumes on the occasion of the marriage of the Prince of Piedmont, when 4000 individuals, representing all parts of Italy, dressed in the correct traditional costumes, paraded past the

Prince and his bride The programme, giving the list of costumes, with many illustrations, is repeated in the volume

While the object of the Institute is practical so far as it aims at the promotion and preservation of popular art and festivals, it does not neglect the interests of the student of custom Coloured photographs have been taken of all the peasant costumes and of a large number of the more important festivals Some have also been filmed A national committee is being set up in collaboration with the League of Nations for the scientific study of Italian folklore In the meantime the student of folklore will find much to interest him in the Institute's publication, while he will register a debt of gratitude for its respect for tradition

### Research in the Metropolitan-Vickers Laboratories

THE Metropolitan-Vickers Research Department at Trafford Park, Manchester, during last year has been making increasingly important researches to find the scientific data forming the basis of engineering development It has continued its researches on the effect of high temperatures on the materials used in turbine construction and on the slow rate 'creep' tensile tests on steels of various compositions and of various shapes The effects of thermal action which were found to make steel brittle have been investigated in the case of alloy steels The high-frequency furnace equipment of the Department has been found most useful in connexion with experiments on the properties of molybdenum steels As there is a great demand for accurate data about the thermal characteristics of metals, very sensitive apparatus was constructed with this end in view Prolonged investigations were made on the cooling effect of fins fixed on the outside of tubes carrying hot fluids Experiments were also made on the converse problem of the cooling effect produced when cold water flows in the pipes causing convection currents of cold air

Work has been continued on chromium plating, and the critical thicknesses of the nickel and chromium necessary to ensure protection of brass and steel have been determined Considerable difficulty had been experienced in the plating of high carbon spring steel, but satisfactory coatings can now be obtained on this type of material The application of cadmium plating as a corrosion resistant has been extended to various processes used in the shops

Much electrical and magnetic research work has been done in the Metropolitan-Vickers laboratories The heating of parts of steel structures due to the

eddy currents induced in them by conductors carrying large alternating currents in their neighbourhood has been investigated and methods have been devised for avoiding the production of this local heating in the structures Theoretical and experimental investigations have been carried out to settle questions which arise in the design of high-pressure voltmeters Continuous research is also being carried out with regard to the cooling radiators used on transformers The work on core losses has been carried out up to cores of 30,000 kva Other problems discussed in connexion with transformers show the great demands made on the physical knowledge and mathematical skill of the experimenters They discuss, for example, the distribution of the transient voltages in the coil windings, the effects of magnetic fields on the performance of precision current transformers, the design of high-frequency transformers and Petersen coils for the protection of overhead networks A 50,000-volt 10,000-frequency transformer has been constructed and satisfactorily operated

The research on the best heat treatment for magnet steels intended to be used in meters has been completed, and so also has the effect of current impulses on permanent magnets Three experimental acoustical investigations have been completed for the engineers of the Mersey tunnel, and experimental work has been carried out on methods of preventing the noise made by fans Preliminary tests were made on the 500-kw. valve used at the P O Radio Station at Rugby, and it was run up until its output was 520 kw The use of radio waves of lengths about one metre—'quasi-optical' waves—is being actively investigated and is said to be promising

### Specificity in Catalysis

IN the thirty-third Robert Boyle Lecture, Sir Frederick Gowland Hopkins deals with the "Problems of Specificity in Biochemical Catalysis" (Humphrey Milford Oxford, 1931) He points out that the isolation of biological products and the determination of their constitution are not the end-points of biochemical research, but rather steps on the path to the investigation of the dynamic events of metabolism in the living cell In these events catalysts play an important part Owing to their specificity it appears that there must be a large variety within the confines of a single cell the acceptance of this conclusion presents to many an intellectual difficulty, which Sir Frederick considers may be

profitably discussed anew in the light of the fresh facts which are now available

After a brief reference to the hydrolytic enzymes, of which a great variety is known, usually one for each stage in the hydrolysis of any complex molecule, recent work on oxidation is reviewed Many oxidations are carried out by dehydrogenases which activate the hydrogen in the oxidisable molecule so that it can be taken up by molecular oxygen or other hydrogen acceptor The xanthine oxidase can transfer hydrogen direct to molecular oxygen other dehydrogenases can transfer it direct to an acceptor such as methylene blue, but not to oxygen until the latter has also been activated. Keilm's cytochrome,

an iron-pyrrol compound, plays an important part here activated by indophenoloxidase, it acts as an intermediate carrier of hydrogen to oxygen from the various substrates activated by the dehydrogenases.

Warburg considers that his respiratory enzyme, again an iron-pyrrol derivative, controls the whole field of oxidations. It shows no spectrum, in contrast to cytochrome, but forms reversible combinations with carbon monoxide as well as oxygen, the former of which is decomposed by light. By examining the effectiveness of different wave-lengths in restoring respiration after it had been inhibited by carbon monoxide, Warburg was able to determine the absorption spectrum of the enzyme, since light must be absorbed by the carbon monoxide compound in proportion to its effectiveness in dissociating it.

Another path for the transport of hydrogen to oxygen is that associated with the reduction and

oxidation of glutathione. Quantitatively it is less prominent than the cytochrome path, but it is essential to the normality of the cell. The cytoplasm of the latter appears to be a lyophil colloidal system in which the micellæ or particles which form the internal phase must be diverse in respect of their surfaces, and probably no small proportion of these surfaces have catalytic properties. Considering the size of the cell and that as much as 75 per cent of cytoplasm is water, of which much is free, it may be assumed that diffusion, as known in macro systems, plays only a negligible part in the velocity of change here, and that contacts between substrate molecules and dispersed particles with catalytic surfaces must continually occur. In such a system a multiplicity of reactions does not appear impossible, whilst the immense numbers of cells in a tissue permit of macroscopic quantities being metabolised.

### Sir Ambrose Fleming and the Physical Society of London

THE meeting of the Physical Society held on Feb 19 marked an event which is probably unique in the history of learned societies. If we open the Society's first minute book (which has fortunately been preserved) we find that the young Society held its first business meeting on Feb 14, 1874, when, 29 members being present, a list of officers was drawn up. Dr J H Gladstone, F R S, father-in-law of the present Prime Minister, was elected to the presidential chair, Profs Grylls Adams and Carey Foster were appointed as vice-presidents, Dr E Atkinson and Prof A W Remond were joint secretaries, and—the holder of an office which has fallen into abeyance—Prof Frederick Guthrie was appointed as the Society's demonstrator.

The next record on the minutes must be transcribed *literatim*. It reads—"A meeting of the Society was held in the Physical Laboratory, South Kensington Museum, at 3 P M on Saturday, March 21st [1874], Dr Gladstone in the chair. There were about 35 members present. The chairman gave a brief description of the objects and organisation of the Society, and noticed the very favourable circumstances under which the Society originated as compared with those attending the origin of its parent, the Royal Society. He announced that 99 gentlemen had already expressed their desire to join the Society as original members."

"J A Fleming, B Sc, read a paper on the new Contact Theory of the Galvanic Cell. Professor F Guthrie exhibited experiments illustrating the distribution of a galvanic current on entering and leaving a conducting medium."

"Prof G C Foster, Dr Wright, and Dr Gladstone took part in the discussion of the communications."

Can any other society produce such a record? It may be that a greater span of years separated Laveing's first and last papers read before the Cambridge Literary and Philosophical Society, but we know of no other instance in which the reader of the first paper at the first scientific meeting of a society has survived to communicate a paper to the society nearly sixty years later.

Inspection of the list of members published in 1930 shows that, of the founder fellows, four—Armstrong, Fleming, Schuster, and Unwin—are still with us. Lodge joined the Society in February 1875, and of those who entered the ranks in the 'seventies, fourteen still remained at the time of publication of the list consulted. President and Council have long since

disappeared—Carey Foster was probably the last survivor of the original officers—but it would be interesting to know if any of the early members were present when "J A Fleming, B Sc" presented his paper.

It is a far cry from the contact theories of 1875 to the wave mechanics of 1932, and Sir Ambrose Fleming has not only made history in this interval, but also still holds a place on the stage of contemporary events. He has read some thirty-five papers before the Society, and his latest paper, on "Electrons and Light Quanta", admirably illustrates the conservation of his powers as teacher and experimenter.

In his introductory section, Sir Ambrose states, clearly and succinctly, the fundamental facts concerning the antinomies, which, even though as yet unsolved, have almost ceased to perplex us. He calculates the value of the mean energy density of bright sunlight at earth distance, and, using four methods, he obtains from the mean of 10 equidistant ordinates of the Planck curve, 48, from the solar constant, 45, from the Stefan constant, 54, from the integration of the Planck equation, 55—all expressed in micro-ergs per cubic centimetre. As the illumination of bright sunlight is about 13,000 candle-feet at normal incidence on a white surface, it is possible to estimate the radiation density of other light beams and the average number of photons per cubic centimetre.

Experimentally, Sir Ambrose proceeded to investigate the question, which he states thus: "If then a beam of light can in any way be regarded as a stream of photons or light quanta each having energy and mass, and if the wave energy is electromagnetic in nature, the question arises whether a stream of electrons moving along a beam of light would have their velocity increased or diminished according as they moved with or against the direction of propagation of the light."

As a preliminary experiment with an arc lamp showed no result, Sir Ambrose employed a powerful beam of X-rays. The source of electrons was a special form of Fleming thermionic valve with a dull-emitter filament and two grid anodes of rectangular section fixed on either side. Hence if "a beam of radiation was passed transversely across the valve the electrons on one side of the filament moved against the radiation and on the other side with it". A simple circuit was arranged which would show by means of a differential galvanometer whether the

incidence of the X-ray beam produced any steady variation from equality in the two electron streams to the two anodes of the valve. No change was detected, although the galvanometer was competent to show a change of 0.05 per cent of the anode electron-currents to the grids. ALLAN FERGUSON

### Archæology of Eastern Colorado

THE archæological survey of eastern Colorado carried out in the summer of 1930 by the University of Denver and the Colorado Museum of Natural History, under the direction of Dr. E. B. Renaud, with the assistance of a subsidy from the Smithsonian Institution, is the first systematic archæological work undertaken in that area, and links up the exploration of south-west Colorado on one side, and of Nebraska and States east on the other. Ten thousand miles were covered in ten weeks. A large number of surface finds were collected, but no excavation was possible in the time. The report of Dr. Renaud and his assistants (published by the University of Denver, Anthropological Department) states that few important sites were left unvisited, and the collections and notes, while not exhaustive, are fairly representative of the Indian culture of Colorado.

The area of closest settlement is in the north-west, in Larimer County, with thirty-eight sites. The contiguous counties, extending from the Rocky Mountains to the States of Nebraska and Kansas without a break, form a vast central group separated by a trough from the smaller and isolated north-west group.

The camp site is the most common (247). Here flaked artefacts and chips are fairly well grouped. Old fireplaces and tipi-rings—stone circles, on which the skins rested, marking the base of the tent—are the most certain criterion of a camp site. An unexpected number of the grinding-stones known as *mano*, or hand-stone, were found. The *mano* is smaller in the pueblo area. Pottery, previously accounted unknown or rare in the western plains, was recorded on fifty-five sites. Fifty-two workshop sites and fifteen rock-shelters were visited. Petroglyphs, rarely painted and most commonly pecked, were found on fourteen sites. Dr. Renaud has made a careful study of the stone implements, comparing them exhaustively with those of the stone age of Europe and other parts of America. The greater number are non-palæolithic, next in importance being Mousterian-like points, scrapers, and flakes.

In 1931, according to a communication we have received from the Department of Anthropology in the University of Denver, the expedition covered the archæologically rich area known as the "Spanish Diggings" in the neighbourhood of Cheyenne and Larimer. About two hundred Indian sites were visited and recorded, and a large number of artefacts were collected. The pictographs were fewer in number than was expected. Pottery was found on a number of sites, and a number of camps showed tipi-rings. The expedition was particularly impressed by the resemblance of old quarries, from which red chert, yellow jasper, and quartzite have been obtained, to the prehistoric quarries of western Europe, except for the fact that the latter had yielded flint. The relative age of these quarries is being investigated by the examination of the growth of lichen. A rapid excursion was made to north-east Wyoming, archæologically a much less interesting area, but it is anticipated that western Wyoming, when its turn comes for exploration, will yield interesting remains, especially in the form of pictographs.

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### University and Educational Intelligence

**BIRMINGHAM**—In his report to the annual meeting of the Court of Governors held on Feb. 25, the vice-chancellor and principal, Sir Charles Grant Robertson, gives the figures for the number of students. The total for the past session was 1890, which approaches the maximum reached in the 'boom' period after the War. The new entries for the present session also show a marked increase. The postponement for a year (on account of national financial stringency) of the building of the new Hospital Centre and Medical School is a matter of grave concern, in view of the increasing congestion of the present buildings.

**CAMBRIDGE**—A report of the Syndicate on the Scott Polar Research Institute recommends that steps be taken to proceed with the erection of a polar research institute on the Lensfield site. The generous gift of £4000 by the trustees of the Pilgrim Fund last year has now made up the capital of the building fund to £12,000, which is considered sufficient to provide for the cost, equipment, and maintenance of the institute which the Syndicate has in view. The financial board while raising no objection to the recommendations has expressed the hope that every effort will be made to increase the endowment of the institute.

**LONDON**—Dr. G. F. J. Temple, at present reader in mathematics at the Imperial College, Royal College of Science, has been appointed to the chair of mathematics at King's College, as from Aug. 1.

The William Julius Mickle fellowship for 1932 has been awarded to Dr. Philip Eggleton, for his research on the labile compounds of phosphorus in muscle.

THERE will be an election to Beit fellowships for scientific research in July next. Applications, upon a form supplied upon request, must be received by April 12 by the Rector, Imperial College of Science and Technology, South Kensington, S.W. 7.

THE annual examinations for a Faraday scholarship of eighty guineas per annum, tenable for two years in the Faraday House Electrical Engineering College and one year in a manufacturing works, and for a Maxwell scholarship of sixty guineas per annum tenable for two years in the College and one year in a works, will be held at Faraday House on April 5-7. Further particulars may be obtained from the Registrar, Faraday House Electrical Engineering College, 62-70 Southampton Row, W.C. 1.

THE Rockefeller Foundation's disbursements in 1930 amounted, exclusive of administration expenses, to nearly fifteen million dollars, of which universities and other educational institutions received more than six millions, research institutions and organisations more than two millions, whilst public health work absorbed nearly three, and fellowships and grants in aid more than one million. The field of the Foundation's activities embraces, in addition to its International Health Division in which expenditure since 1913 has amounted to 42 million dollars, work in the medical sciences, natural sciences, social sciences, and the humanities. In the International Health Division particular emphasis has in recent years been laid on field work, including the gathering of knowledge about widespread maladies such as hook-worm, malaria, pellagra, yellow fever, tuberculosis, and the common cold. All results of researches by members of the field staff of the Foundation or by persons working under its auspices are published (to the number of 57 in 1930).



in the medical journals International Health Division fellowships are given to graduates in medicine of high professional standing and assured of positions in the public health services of their own countries In 1930, 173 such fellowships were held by natives of 33 countries, including the United States and its dependencies (52), China (18), Canada (12), Italy (12), other European countries (47), Brazil (8), India (8) In addition, the Foundation supported 102 fellowships in medicine for the supplementary training of young graduate physicians, from 35 countries, in preparation for definite positions in research or teaching Among enterprises aided by the Foundation are an institute of experimental biology in Copenhagen, an institute of cell physiology in the Kaiser Wilhelm Institute of Biology, and the Kaiser Wilhelm Institute for Brain Research

### Calendar of Geographical Exploration

#### March 2, 1705 — Coast of Northern Australia

Maarten van Delft sailed from Timor and surveyed the coasts of Melville Island and of the Coburg Peninsula, thus supplementing Tasman's chart of the region One of the vessels penetrated some distance into Dundas Strait

#### March 4, 1519 — Cortes in Mexico

Hernando Cortes landed in Mexico The discovery of Mexico by Juan Grijalva led Velasquez to entrust to Cortes the exploration and conquest of the country Starting from the coastal regions near the modern Vera Cruz, Cortes marched to the city of Mexico, sending a party to explore the snow-clad Popocatepetl *en route* The city was captured in August 1521, and Cortes sent out exploratory parties in all directions, Alvarado making some conquests in Guatemala Cristobal de Olid, who had been ordered to reach Cuba via Honduras, reached the southern shores of the gulf, but mutinied against Cortes The latter left Mexico in 1524 and marched through Tabasco to the Gulf of Honduras There he again sent out exploring parties from the town now known as Puerto Cortes and later from Trujillo

#### March 4, 1791 — Islands of the Pacific

Capt Edwards, in the *Pandora*, sighted Easter Island on a voyage undertaken partly in search of the mutineers from Bligh's vessel These men had apparently appreciated life in the South Sea islands so much that they wished to remain Some of them successfully settled in Pitcairn Island Edwards discovered some small islands in the Low Archipelago, and later, in his search for the mutineers, covered much of the Pacific not usually touched in trading voyages, thus many previously unknown islands were charted In the neighbourhood of Torres Strait the *Pandora* was wrecked, some of the crew were drowned, but others escaped in the boats and after terrible hardships reached Timor

#### March 4, 1905 — Charcot Land

Dr Jean Charcot in the *Français* arrived in Puerto Ladrada, Argentina Charcot had planned a voyage to the Antarctic to rescue Dr O Nordenskjöld, but this had been effected by an Argentine vessel Charcot then, in the course of two summer cruises, surveyed parts of the west coast of Graham Land and reached Alexander I Land His vessel was delayed by ice and anxiety was felt about its possible fate, but in spite of severe damage it escaped In 1908-10, Charcot returned to the Antarctic and discovered the land which now bears his name

### Societies and Academies

#### LONDON

Royal Society, Feb 18 — D'Arcy W Thompson The geometry of the siliceous skeletons of the Radiolaria. The figures of equilibrium and minimal area which are assumed by soap-films in Plateau's experiments have proved helpful in explaining the configurations of various cells and simple tissues in plants and animals Among the most curious and anomalous of cell-forms are those of certain Radiolaria In some of these the skeleton resembles a minute spiked helmet with three curved lappets or straps below Even such an anomalous configuration as this may be precisely imitated or reproduced by an artificial system of liquid films — H W S. Massey and C B O Mohr The collision of slow electrons with atoms (1) The theory has been developed in which the zero approximation is not a plane wave but the wave representing the motion of the electron in the static field of the atom concerned Exchange does not become very important until voltages lower than those obtained on Born's theory using the plane wave as first approximation At lower voltages, strong interference effects occur between the incident and exchanged electron waves, giving peculiar angular distributions of the scattered electrons These effects are observed experimentally — H C Webster The artificial production of nuclear  $\gamma$ -radiation The production of nuclear  $\gamma$ -radiation by bombardment with  $\alpha$ -particles has been observed for the elements Li, Be, B, F, Na, Mg, Al Negative results were obtained with H, C, N, Ni, Cu, Sn The absolute efficiencies of production of the various radiations range from about 0.5 quanta per million  $\alpha$ -particles for magnesium to about 30 quanta for beryllium In addition, the way in which the efficiency of production varies with the residual range of the  $\alpha$ -particles was investigated The processes probably responsible for the radiations are discussed some appear to be due to the capture of an  $\alpha$ -particle by a nucleus without proton emission, others are probably due to a secondary process following proton emission, others may arise from inelastic collisions without capture

Geological Society, Dec 16 — J E Richey The Tertiary ring complex of Slieve Gullion (Ireland) This complex lies west of the Mourne Mountains and north-west of the Carlingford Peninsula Topographically, it consists of a ring of curving ridges and hills, 7 miles in diameter, which is bisected by a mountainous belt extending to the north-west The ring and the north-west belt mark the outcrops of a very simple ring-dyke complex and later Tertiary plutonics The ring complex forms a complete ring, except to the south-west, where it is broken through by the north-west belt The almost exact coincidence of the ring-fissure with the margin of the western portion of the Newry granite is perhaps its most remarkable feature The constituent rocks of the ring are given

#### PARIS

Academy of Sciences, Jan 11 — E Jouguet Remarks on a theorem of Hugoniot relating to the flow of fluids — Maurice Hamy A property of the equation obtained by equating to zero the distance of two planets,  $P, P_1$ , which do not meet at real points — Paul Qvale Remarks on Thiele's semi-invariants — Georges Bouligand Various problems of infinitesimal geometry — N Aronszajn The decomposition of uniform functions — W Orlicz Some theorems on orthogonal developments — René de Possel *Étudiées* functions and ensembles of the

maximum type—E. Kogbetliantz The convergence of Hermite's series—N Abramesco The determination of holomorph functions in given domains—Marcel Guillot Reade's iriscope and the aptitude of solid and liquid surfaces to be moistened by water This method of testing the cleanness of a surface is based on the condensation on the surface of a small quantity of water vapour and subsequent examination of the interference effects produced Glass cleaned with hot sulphuric acid containing chromic acid is found to be clean only in certain spots Only surfaces obtained by fracture, by fusion, or prolonged treatment with hydrofluoric acid were found to be perfectly clean when tested by this method—E Henriot and O Goche Cathodic sputtering in a magnetic field Cathodic sputtering in a magnetic field produces a deposit on a screen, the position of which varies on reversing the field This deposit is due to carbon, and is independent of the nature of the metal employed as the cathode The origin of the carbon is discussed—Georges Fournier and Marcel Guillot The increase of absorption of the  $\beta$ -rays in molecules possessing certain linkages between the atoms—André Chevallier and Pierre Dubouloz The application of fluorescence to photometric measurements in the ultra-violet J and J F Thovet have proposed the utilisation of photoelectric cells with thin walls (the latter being covered with a thin layer of a fluorescent substance) for detecting radiations of short wave-length This method has been studied in detail with special reference to the composition of the fluorescent layer An emulsion of dextrin and sodium salicylate has been found to give the best results—Marcel Godchot, Etienne Canals, and Mlle Germaine Cauquil The Raman spectrum of some cyclohexane hydrocarbons Comparison of the Raman spectra of cyclohexane, methylcyclohexane, the three isomeric dimethylcyclohexanes, and of hexane The spectra are generally similar, but there are differences to which attention is directed—Henri Lafuma The solution and hydration of quicklime in the presence of calcium sulphate—E Herzog and G Chaudron The methods of testing the corrosion of metals Comparison of the effects of uniform and localised corrosion Localised corrosion, in which no appreciable loss of weight of the specimen is noted, may have a marked effect on the mechanical tests—G Darzens and Georges Lévy The method of preparation of phenols by the direct dehydrogenation of the corresponding hydroaromatic ketones Application of the removal of hydrogen by heating with sulphur—Charles Dufraisse and Léon Enderlin The formula and constitution of a colourless hydrocarbon with a violet fluorescence,  $C_{42}H_{26}$ —M Battegay and J Meybeck The amino-sulphonamides By the interaction of *N*-chlorosulphonylacetyl chloride,  $C_6H_5(CO \cdot CH_2)N \cdot SO_2Cl$  upon dimethylamine, phenylaminodimethylsulphonamide ( $C_6H_5 \cdot NH \cdot SO_2 \cdot N(CH_3)_2$ ) is obtained The dimethylamine can be replaced by other amines, giving the corresponding amino-sulphonamides—Mme Ramart-Lucas and Mlle Biquard The prediction and verification of the colour differences between isomers—A Marin and P Fallot The geology of the Punta Pescadores region (Spanish Rif)—A Dauvillier The theory of the polar aurora—Robert Lemesle A structural peculiarity in the various species of *Kadsura* The presence of small crystals of calcium oxalate in certain tissues appears to be general in all species of *Kadsura*—Pierre Chouard The diversity of the generic characters of the flowers, bulbs, and seeds in the genus *Ornithogalum*—P Lebard The influence of altitude on the tuber formation of the potato The existence of an optimum altitude Comparisons of tuber formation

of the potato at altitudes of 214, 1500, 1650, and 2100 metres above sea-level The alpine climate favours tuber production, the highest yields being obtained at 1500 metres—A Policard, A Morel, and P P Ravault The histospectrographic study of the localisation of calcium and magnesium in the human aorta, and their variations during atheroma—Émile F. Terroine and Mlle Marguerite Champagne The influence of the acid-base ratio of diet on the magnitude of the nitrogen metabolism—Émile Guyenot and Mlle A Moskowska and K Ponse The direct action of the hypophysis on the nuptial pad of *Bombinator pachypus*—Mme Y Khouvine, G Champetier, and R Sutra The X-ray study of the cellulose of *Acetobacter xylinum*—René Legroux Transmissible bacterial lysis The principle producing lysis behaves towards antiseptics as a diastase That it is a living organism is shown to be improbable

#### MELBOURNE

Royal Society of Victoria, Dec 10—A B Edwards The dacite-granodiorite contact relations in the Warburton area A granodiorite of Upper Devonian age is found intruding a contemporaneous series of dacites in the Warburton area (Victoria), at Nyora (Mt Tool-be-wong), and south of Warburton township At Nyora the dacite is but slightly altered At Warburton three members of the dacite suite enter the metamorphic aureole of the granodiorite, and are converted into ortho-schists and ortho-gneisses, with accompanying mineral changes As the granodiorite is approached, hypersthene is replaced by biotite, which in turn gives place to green hornblende A patch of anthophyllite-garnet rock is developed from the hypersthene-dacite, apparently by repeated metamorphism Andalusite is developed in the metamorphosed argillaceous sediments of Silurian age which enter the contact aureole—Elizabeth A Ripper Palaeontological zoning of the Lower Ordovician near Inghston The Lower Ordovician slates and sandstones, three miles south-east of Inghston, are shown by their graptolite faunas to belong to the uppermost zone of the Castlemaine series and all the Darriwil series, with the exception of the uppermost zone (D 1) Passage beds between D 5 and D 4 with *Oncograptus upsilon* and *O. biangulatus* have been recognised The area is the western limb of a geosyncline, of which the axis is unknown, since there is a passage from C 1 in the west to D 2 in the east, where beds of this age outcrop in the Werribee Gorge.—Frederick Chapman Some palaeozoic fossils from Deep Creek and Evans' Creek, Saltwater River, Victoria A preliminary note on the Deep Creek fossils by the author, published in 1903, gave a Silurian (doubtfully Yeringian) age to the collection from that locality The conclusions now arrived at are a Silurian age for both collections, with a leaning towards the lower or Melbournian stage—Walter J Parr Victorian and South Australian shallow-water Foraminifera (2) This part deals with the remainder of the material studied in Part 1, together with some additional species discovered since The new species are *Gaudryina hastata*, *Vaginulina vertebralis*, *Bohvinella elegans*, *Reussia armata*, *Discorbis australis* *D. collinsi*, and *Anomalina nononoides*—S Illichersky Does the flowering of plants of the Victorian flora repeat the order of their evolution?—Jean Heyward The relation between flowering and degree of evolution—Donald McCance Weathering of the older basalt of Royal Park, Melbourne A series of chemical analyses of different stages of decomposition of the rock, from the fresh basalt to the residual clay, are given By means of a table based on these analyses the calculated losses of material, due to weathering, in the various stages, are compared A

petrological description of the basalt is given, whilst the evidence points to the decomposition having been caused by infiltration of solutions from without — F A Singleton Studies in Australian Tertiary Mollusca (1) This paper deals with the status of fossils hitherto recorded as *Nucula obliqua* and *Lumopsis insolita*. Included in the paper are descriptions of the following new species and sub-species from the Australian Tertiaries *Nucula kalmanæ*, *Glycymeris granti*, *Lumopsis chapmani*, *L. chapmani valida*, *Cucullæa corcoensis prelonga* — David E Thomas The Kerrie series and associated rocks The Kerrie series of conglomerates and associated sandstones, to which various ages of basal Upper Ordovician and basal Silurian have been given, rests unconformably on the upturned edges of the Upper Ordovician The Lower and Upper Ordovician of the area are conformable, and no stratigraphical break has been proved between the Upper Ordovician and the Silurian On the similarity to rocks elsewhere in the State an Upper Devonian age is assigned to the conglomerate

## VIENNA

Academy of Sciences, Oct 22 — R Weiss and F. Muller: Triphenylmethanes the benzol nuclei of which are connected (6) Trimethylene-triphenylmethane-triketone-4-carbonic acid and its reduction. — F Wessely and F Kallab Substances contained in the root of *Pimpinella saxifraga* Pimpinellin and isopimpinellin belonging to the coumarins and coumarone series — F Feigl and L Popp-Halpern The salts of *o*-, *m*-, and *p*-phenylene-diamine with organic acids — G Lock and F Asinger Steric inhibition in the saponification of benzal chlorides (1) — G Machek The anhydride of the symmetrical pyridine-tetracarboxylic acid and some of its condensation products — O Dischendorfer and E. Fransevic *p*-chlor-benzal-di- $\beta$ -naphthol (sixth communication on condensation of aldehydes with phenols), also anthraquinone-2 l, 6 5-di-xanthon — M Pestemer and J Cecelsky Ultra-violet absorption of some aromatic hydrocarbons — F Werner New Orthoptera collected during an expedition to Morocco undertaken with the help of the Academy in 1930 — R Wagner Mixed monochasiums of *Prinqueta subfoha* Curious inflorescences — R Weiss has deposited a sealed manuscript with the inscription "Stereochemie" and relating to acemic compounds with optically active substances

Oct 29 — K Funke Perylene and its derivatives 33) The constitution of perylene-diamines — P Schebesta and V Lebzelter Anthropology of the pygmies of the Belgian Congo In the years 1929-30 some 550 pygmies were measured They were of various tribes, some more, others less, racially pure Efe, Bambuti, Bakango, Aka, Bacwa, Batwa, Basua occupy different districts

Nov 5 — F Arndt, J. Amende, and W Ender syntheses with diazo-methane The reactions of aldehydes and ketones — F. Heritsch The tectonic structure of the Carnic Alps — E. Habersfelner Geological survey between Kronhofgraben and Fuchsraben — W. Krassuski Geological survey of the eastern Carnic Alps and of the western Karawanken — I Peltzmann Graptolites from Dellach (Zollner) Alm — F Kahler: Investigations on the Fusulinidae of the Carnic Upper Carboniferous — K Metz Detailed survey of the Nassfeld deposits in the neighbourhood of the Ahornach Alp — H. Heritsch Survey in the crystalline rocks of the Gail valley — H Tertsch cleavage measurements in the pressure planes of rock-salt and deductions concerning the cleavage process The rhombododecahedral surfaces were tested in the same way as the cubic surfaces — Brukl and B Hahn Heteropoly-acids of germanium — B. Machan New fish from Java

## Forthcoming Events

## FRIDAY, FEBRUARY 26

ASSOCIATION OF ECONOMIC BIOLOGISTS (Annual General Meeting) (in Botany Lecture Theatre, Imperial College of Science and Technology), at 2 30 — At 3 — Dr H Tattersfield, F R Cann, and others Discussion on Laboratory Tests of Insecticides — At 5 30 — Presidential Address Temperature and Humidity in Relation to Insect Control

ROYAL ASTRONOMICAL SOCIETY (Geophysical Meeting), at 4 30 — Dr S F Grace A Method for the Determination of the Tides of a Broad, Deep Sea, with Application to the Gulf of Mexico — Dr H Jeffreys (a) On the Stresses in the Earth's Crust required to support Surface Inequalities, (b) The Deformation of the Earth due to Asymmetrical Cooling

BRITISH PSYCHOLOGICAL SOCIETY (at 54 Russell Square, W C 1), at 8 30 — Dr Susan Isaacs Some Recent Advances in the Psychology of Children (Lecture)

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 — Prof C G Darwin The Uncertainty Principle in Modern Physics ASSOCIATION OF TECHNICAL INSTITUTIONS (Annual Meeting) (in Leathersellers' Hall, St Helen's Place, E C) — Prof R W Angus Technical Education in Canada — W H Quinn Technical Education in the Bakery Trade. — P G Wilson Teaching of Modern Languages in Technical Colleges — J Cameron Small The Report on Policy in Technical Education — Sir Francis Goodenough The Report on Education for Salesmanship

## SATURDAY, FEBRUARY 27

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 — Lord Rutherford of Nelson Discovery and Properties of the Electron (1)

ASSOCIATION OF TECHNICAL INSTITUTIONS (Annual Meeting) (in Leathersellers' Hall, St Helen's Place, E C) (continued)

## TUESDAY, MARCH 1

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 — Dr L J Witts The Pathology and Treatment of Anæmia (Goulstonian Lectures) (1)

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 — Prof W E Garner Detonating Substances (1)

## WEDNESDAY, MARCH 2

ROYAL SOCIETY OF ARTS, at 8 — E C Gordon England: Motorless Flying

## THURSDAY, MARCH 3

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 — Dr L J Witts The Pathology and Treatment of Anæmia (Goulstonian Lectures) (2)

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 — Prof J B S Haldane Heredity in Man (3)

## FRIDAY, MARCH 4

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society) (Annual General Meeting), at 3 — Presidential Address

INSTITUTE OF MARINE ENGINEERS, at 6 — Annual General Meeting

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7 30 — Prof W G Fearnside The Carboniferous Rocks of Derbyshire Derwent (Lecture) — W Pulfrey On the Occurrence of Radiolarian-bearing Nodules at the Base of the Edale Shales, near Calver, N Derbyshire (In Abstract)

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 — Sir Harold Hartley Michael Faraday and Electro-Chemistry

## SATURDAY, MARCH 5

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 — Lord Rutherford of Nelson Discovery and Properties of the Electron (2)

## Conference

## MARCH 2 AND 3

CONFERENCE ON LIGHT IN ARCHITECTURE (Lighting Service Bureau, 15 Savoy Street, W C 2)

- Wednesday, March 2, at 10 A.M.—H. A. Lingard Introductory Remarks  
 At 10 15 A.M.—Dr J. W. T. Walsh Lighting Fundamentals  
 At 11 15 A.M.—L. E. Buckell Characteristics of Electric Lamps  
 At 12 15 —Discussion  
 At 2 15 —W. Maitland Aims and Objects of Architectural Lighting Discussion  
 At 3 30 —Mr. Grierson Electrical Services for Lighting  
 At 4 15 —Discussion  
 Thursday, March 3, at 10 A.M.—Sir John Brooke Introductory Remarks  
 At 10 15 A.M.—H. Lingard Floodlighting Discussion  
 At 11 30 A.M.—W. J. Jones Special Lighting Problems Discussion  
 At 2 15 —F. Marsh Lighting Requirements for Commercial Buildings Discussion  
 At 3 30 —H. Robertson Modern Tendencies in the Lighting of Theatres, Hotels, Restaurants, and Exhibitions Discussion

## Official Publications Received

### BRITISH

- Recent Advances in the Fermentation Industries By Dr J. Vargas Eyre (Streatfield Memorial Lecture, 1931) Pp 20 (London Institute of Chemistry)  
 The Indian Forest Records Entomology Series, Vol. 16, Part 8. New Indian Curculionidae (Col.) By Sir Guy A. K. Marshall Pp ii+16+1 plate 6 annas, 8d Entomology Series, Vol. 16, Part 9 The Life History and Control of *Celosterna scabrator* F. (Col., Cerambycidae) By C. F. C. Beeson Pp ii+16+2 plates 8 annas, 10d (Calcutta Government of India Central Publication Branch)  
 Economic Advisory Council Committee on Education and Supply of Biologists Report Pp 68 (London H.M. Stationery Office) 1s net  
 Report on the Administration of the Meteorological Department of the Government of India in 1930-31 Pp 26 (Calcutta Government of India Central Publication Branch) 8 annas, 10d  
 Publications of the South African Institute for Medical Research No. 28 Illustrated Keys to the Full-grown Larvae and Adults of South African Anopheline Mosquitoes By Botha de Meillon Pp 275 3/5 (Johannesburg)  
 Royal Society of Arts Report on the Competition of Industrial Designs, 1931 Pp 43 (London Royal Society of Arts)  
 Madras Fisheries Department Administration Report for the Year 1917-18 By Sir F. A. Nicholson (Report No. 7 of 1917, Madras Fisheries Bulletin, Vol. 11) Pp iv+173 208 8 annas Fish Statistics for 1927-28 Supplement to the Administration Report for 1928-29 Edited by Dr B. Sundara Raj (Report No. 2 of 1930, Madras Fisheries Bulletin, Vol. 24) Pp ii+105 197 10 annas (Madras Government Press)  
 Transactions of the Institute of Marine Engineers, Incorporated Session 1931, Vol. 43, No. 12, January Pp 561 610+xxxviii (London)  
 City and County of Bristol Bristol Museum and Art Gallery Report of the Museum and Art Gallery Committee for the Year ending 30th September 1931 Pp 28+4 plates (Bristol) 2d  
 East African Agricultural Research Station, Amami Third Annual Report, 1930-1931 Pp 35 (London H.M. Stationery Office) 1s net  
 The Institute of Physics List of Members, January 1932 Pp 27 (London Institute of Physics)  
 Proceedings of the Cambridge Philosophical Society Vol. 28, Part 1, 30 January Pp 164 (Cambridge At the University Press) 7s 6d net  
 Leeds University Report to the Worshipful Company of Clothworkers of the City of London of the Advisory Committee on the Departments of Textile Industries and Colour Chemistry and Dyeing during the Session 1930-31 Pp 14 (Leeds)  
 University of Leeds Clothworkers' Departments Report of the Work done under the Research Scheme established in 1928 with the aid of a Special Grant from the Worshipful Company of Clothworkers Pp 30 (Leeds)  
 Colony of the Gambia The Annual Report of the Department of Agriculture for the Year ended March 31st, 1931 Pp 51 (London The Crown Agents for the Colonies) 5s  
 India Meteorological Department Scientific Notes Vol. 3, No. 27 A Study of Thunderstorms in Poona in 1930 By Dr B. N. Desai Pp 87 113 12 rupees, 2s Vol. 4, No. 32 On the Relation between the Weather and the Variation of the Normal Vertical Gradient of Temperature in N.W. India By S. Atmanathan Pp 5-17 9 annas, 1s Vol. 4, No. 34 A Study of Two Pre Monsoon Storms in the Bay of Bengal and a Comparison of their Structure with that of the Bay Storms in the Winter Months By Dr K. R. Ramanathan and H. C. Banerjee Pp 33 47+14 plates 14 rupees, 2s Vol. 4, No. 35 An Improved Method of Sounding the Lower Layers of the Atmosphere By G. Chatterjee Pp 49 51+3 plates 6 annas, 8d Vol. 4, No. 36 Contrivances for lifting the Pens of the Recording Plate of the Dines Balloon Meteorograph during its Descent By G. Chatterjee and P. M. Neogi Pp 53 55+2 plates 5 annas, 6d Vol. 4, No. 37 The Seasonal Forecasting Formulae used in the India Meteorological Department By Dr S. R. Sanyal Pp 57 63 6 annas, 9d Vol. 4, No. 38 Rainfall of Siam, its Normal Distribution and Relation to Indian Rainfall, Possibility of Forecasting Monsoon Rains By V. Doraiswamy Iyer Pp 69 85+5 plates 1 rupee, 1s 9d (Calcutta Government of India Central Publication Branch)

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### FOREIGN

- Department of the Navy Bureau of Navigation Annual Report of the Naval Observatory for the Fiscal Year 1931 Pp 23 (Washington, D.C. Government Printing Office)  
 U.S. Department of Commerce Bureau of Standards Bureau of Standards Journal of Research Vol. 7, No. 6, December 1931, Research Papers Nos. 387-395 Pp 1017 1191 (Washington, D.C. Government Printing Office) 40 cents  
 Scientific Papers of the Institute of Physical and Chemical Research No. 340 On the Mechanism of Breakdown of Steel By Masawo Kuroda Pp 111-123+10 plates 30 sen No. 341 On the Solubility of Gas and Coefficient of Dilatation by Absorption By Jurō Horuti Pp 125 256 95 sen Nos. 342 345 Influence of Air on the Properties of Organic Solvents, by Jurō Horuti Action of Volcanic Ashes on Oils—A Hint of the Origin of Japanese Petroleum, by Torahiko Terada, Morisō Hirata and Tyokurō Utgasaki, Röntgenographische Untersuchung des Cellulose Xanthogenates (Vorläufige Mitteilung), von Ichiro Sakurada und Keirok Hubino, Über die Stereoisomerien einiger Dinaphthylidenderivate und Versuch zur Darstellung optisch aktiven Farbstoffe (Abridgement), von Shunsuk Murahashi Pp 277-298 50 sen (Tōkyō Iwanami Shoten)  
 Communications from the Geological Institute of the Agriculture University, Wageningen, Holland No. 17 Properties and Constitution of a Volcanic Soil, built in 50 Years in the East Indian Archipelago B. Prof. J. van Baren Pp 29+6 plates (Wageningen H. Veenman & Zonen)  
 Calendario del Santuario e delle Opere di Beneficenza Cristiana di Pompei 1932 Pp 288 (Pompei Bartolo Longo)  
 Rendiconti del Seminario Matematico e Fisico di Milano Vol. 5 (1931) Pp xi+225 (Milano Libreria Editrice Politecnica)  
 Rubber Research Institute of Malaya Bulletin No. 4 Summary of Meteorological Records, Soils Division By W. B. Haines Pp ii+2' (Kuala Lumpur) 1 dollar  
 Journal of the Faculty of Agriculture, Hokkaido Imperial University Vol. 32, Part 2 On the Rot Disease of the Seeds and Seedlings of Rice Plant caused by some Aquatic Fungi By Serya Ito and Masaji Naga Pp 45 70+plates 8 11 (Tokyo Maruzen Co., Ltd.)  
 The Science Reports of the Tohoku Imperial University, Sendai, Japan First Series (Mathematics, Physics, Chemistry), Vol. 20, No. 5, December Pp 649 781 (Tokyo and Sendai Maruzen Co., Ltd.)  
 The Science Reports of the National Tsing Hua University Series A Mathematical and Physical Sciences Vol. 1, No. 3, October Pp 93 12 (Peiping) 0.50 Mexican dollar  
 U.S. Department of the Interior Geological Survey Bulletin 824 C The Lake Clark—Mulchatna Region, Alaska By Stephen R. Capp (Mineral Resources of Alaska, 1929) Pp ii+125 154+plate 2 10 cent Bulletin 824 D Mining in the Circle District, Alaska By J. B. Merti Jr. (Mineral Resources of Alaska, 1929) Pp ii+155 172+plate 5 cents Bulletin 824 E The Occurrence of Gypsum at Iyaukeen Cove Chichagof Island, Alaska By B. D. Stewart (Mineral Resources of Alaska, 1929) Pp ii+173 177 5 cents Bulletin 828 Geological and Mineral Resources of the Quakertown—Doylestown District, Pennsylvania and New Jersey By F. Bascom, E. T. Wherry, G. W. Stose and A. Jonas Pp iv+62+4 plates 40 cents (Washington, D.C. Government Printing Office)  
 U.S. Department of the Interior Geological Survey Professional Paper 164 The Kaiparowits Region, a Geographic and Geologic Reconnaissance of Parts of Utah and Arizona By Herbert E. Gregory and Raymond C. Moore Pp vii+171+31 plates 1.05 dollars Professional Paper 165 Shorter Contributions to General Geology, 193 Pp iv+180+43 plates 1.25 dollars Professional Paper 168 Origin and Microfossils of the Oil Shale of the Green River Formation of Colorado and Utah By Wilmot H. Bradley Pp vi+53+23 plates 60 cent (Washington, D.C. Government Printing Office)  
 U.S. Department of the Interior Geological Survey Water-Supply Paper 663 Surface Water Supply of the United States, 1925 Part 1: Ohio River Basin Pp viii+245 35 cents Water-Supply Paper 668 Surface Water Supply of the United States, 1929 Part 1: North Atlantic Slope Drainage Basins Pp viii+253 40 cents Water-Supply Paper 684 Surface Water Supply of the United States, 1929 Part 4: St. Lawrence River Basin Pp v+123 20 cents Water-Supply Paper 687 Surface Water Supply of the United States, 1929 Part 7: Lower Mississippi River Basin Pp v+88 15 cents Water-Supply Paper 689 Surface Water Supply of the United States, 1929 Part 9: Colorado River Basin Pp v+105 20 cents Water-Supply Paper 693 Surface Water Supply of the United States, 1929 Part 1: North Pacific Slope Drainage Basins B Snake River Basin Pp vi 183 30 cents (Washington, D.C. Government Printing Office)  
 U.S. Department of the Interior Fifty-second Annual Report of the Director of the Geological Survey to the Secretary of the Interior, 1931 Pp ii+95 (Washington, D.C. Government Printing Office) 15 cent  
 Annalen der Hydrographie und Maritimen Meteorologie Zeitschrift für Seefahrt- und Meereskunde Herausgegeben von der Deutschen Seewarte, Hamburg Jahrgang 60 (1932) Heft 1 Pp 48+9 Tafeln (Berlin: E. & M. Mittler und Sohn) 2 gold marks  
 Ministry of Agriculture, Egypt Technical and Scientific Service Bulletin No. 111 Water in Cotton in Egypt, being Memoranda prepared for the International Cotton Committee (Egypt) during 1928-30 By J. W. Lawrence Balls Pp iii+19+3 plates (Cairo Government Press) 5 P.T.  
 Report of the Aeronautical Research Committee, Tōkyō Imperial University No. 77 Hito no Kabe ga Moku no Yoryoku kenshi ni oyobu Bikyō ni suite (Zuduki) (On the Effect of the Walls of a Wind Tunnel upon the Lift Coefficient of a Model—continued) By Tatsumi Sasa Pp 315 340 (Tokyo Kōeikan Publishing House) 0.22 yen  
 Smithsonian Miscellaneous Collections Vol. 87, No. 2 A Mice Long beaked Porpoise from California By Remington Kellogg (Publication 3135) Pp 11+4 plates (Washington, D.C. Smithsonian Institution)

### CATALOGUE

- The Nickel Bulletin Vol. 5, No. 2, February Pp 25 48 (London The Mond Nickel Co., Ltd.)



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## Science and Society

THE leading philosopher of the United States, Prof John Dewey, has in his latest book ("Philosophy and Civilization" \*) joined heartily in the campaign often urged in these columns for a larger scope for science and the scientific spirit, especially among educators and those responsible for social and political action. We are not offering an ordinary review of Prof Dewey's book, as the bulk of it consists of reprints of articles on detailed philosophic questions. But the concluding essay, under the title at the head of this article, is freshly published and raises a large number of tremendous questions in small space. They all merit a treatise apiece, with several supplementary chapters on points suggested but not brought out. One need scarcely say that on the main contention we are in full accord with Prof Dewey. He sums this up in his concluding paragraphs, that "the great scientific revolution is still to come", and that "it will ensue when men collectively and co-operatively organise their knowledge to achieve and make secure social values". "We are living in a period of depression. The intellectual function of trouble is to lead men to think. The depression is a small price to pay if it induces us to think about the cause of the disorder, confusion, and insecurity which are the outstanding traits of our social life. If we do not go back to their cause, namely, our half-way and accidental use of science, mankind will still pass through depressions, which are the graphic record of our unplanned social life. But it is incredible that men who have brought the technique of physical discovery, invention, and use to such a pitch of perfection will abdicate in face of the infinitely more important human problem."

These are true, brave, and wisely hopeful words. We agree wholly with Prof Dewey in his ultimate confidence, and sympathise with him in his chafing at the selfishness and obscurantism which prevent a more rapid advance. But one gains here and there in his article an inkling that the position in the United States must be in some respects more difficult than it is with us. For example, he refers in one place to "the obstacles against which social insurance with respect to accidents incurred in industrial employment had to contend", and says "that the idea of insurance against the risks of maternity, of sickness, old age, and unemployment is fought by all reactionary forces". Here, apparently, the Old World is actually more up to date

\* *Philosophy and Civilization* By Prof John Dewey Pp 334 (New York Minton, Balch and Co, 1931) 5 dollars

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than the New No one could use such language of the State insurance schemes now in operation in Great Britain We have made mistakes of detail in framing them, but they were accepted and welcomed generally by all parties, and it is a commonplace among us that had it not been for such scientific prevision the aftermath of the War would have been incalculably worse—something, in fact, that we shrink from contemplating Prof Dewey invokes Condorcet, in his prison at the Revolution, as the pioneer in applying the calculus of probabilities to insurance against social risks It is well to do so, for many of the most fruitful ideas which are now transforming society were first proclaimed at that time But we on this side of the water should not forget to add the name of Josiah Royce, one of America's most profound thinkers, who worked out on a larger and more practical scale the idea of insurance which had dawned on Condorcet

One gathers, indeed, not only from Prof Dewey's book but also from many other sources, a picture of American mentality of extraordinary interest and acute contrasts There is, on one hand, a much more widely diffused spirit of questioning and of eagerness for some new thing, and, on the other, a more obstinate individualism and a clinging to traditional views as a shibboleth We have nothing quite like that in Great Britain, and it must make any advance on the path of organising society on a scientific basis much more difficult If we may not interpret the legends of Genesis on scientific canons, how shall we fare in dealing with birth-control or the international settlement of the economic crisis?

This brings us to the point for which this article is written—very far, of course, from sermonising to America, the advanced and generous spirits of which have laid the whole world so deeply in their debt But the point is this The science which is to regenerate or reorganise society must be a completely human creation, universal both in its origins and in its outlook Prof Dewey refers at some length, and with a qualified approval, to the Five-Years Plan in Russia Both the reference and the qualified approval are natural enough, but he does not qualify for the most serious reason Drastic political methods, though we may disapprove, are less serious ultimately if they remain domestic The permanent menace and most solid ground for the criticism of the Russian experiment is that she has been proceeding in avowed hostility to the rest of the world Her science is a thing of a special brand, unlike that of the bourgeois world, and to be used to overthrow it *In hoc signo non vinces!*

A similar moral might be drawn, *mutatis mutandis*, from pre-War Germany One does not wish now to be discussing war-guilt, but it is essential to notice that the application of science to social reform, if it is to be permanent and avoid the convulsions and setbacks of the past, must be on an international basis

The working formula under which national and international applications of science to life are to be reconciled is now being worked out by mankind It involves all the most delicate and complicated of contemporary problems, some of which find their solution by waiting and patient trial and goodwill This, perhaps, may be the case with the currency question, but it is certainly not so with all Some demand vigorous initiative and, above all, the alignment of more than one nation in the interests of all the rest We know well that, when the great occasions come, we can count on a host of Americans, of whom Prof Dewey is a notable exponent, to stand for a sane internationalism, scientific by the very nature of the modern world, but also humane The latter condition, unhappily, does not follow as a matter of course Our thoughts are now all turning to the world conference on disarmament There is, no doubt, room for wide difference of opinion on the extent of the armed forces necessary for police and protective purposes by the several States, but there can be none as to the inhumanity and insane misuse of science in the continued elaboration of the submarine and poison gas, *et hoc gens omne* of modern warfare America, we are confident, will stand by us in withstanding the whole hideous business, or at least in relegating it to an international police force, according to Major David Davies' carefully thought-out suggestion

It will be said, no doubt, that it is a matter of education and that the governments of the world cannot go beyond the public opinion of their people This is true only with such qualifications that it might almost be denied All great populations, even the more educated, are capable either of mass suggestion or of intelligent guidance, if they are wisely led and the right method of approach is taken Here is such a moment and an irrefragable cause, in March 1932

For the ordinary education of the modern man in the ways of science and of peace, we should probably look, more than Prof Dewey seems inclined to do, to the older literary and historical curriculum transfused by science He speaks throughout of freedom and allowing the young to inquire and to think for themselves. Without disparaging this,



which is a common attribute of the young, mature opinion on this side would probably give the higher place to synthesis, to inducing in the minds of students the idea that harmony, both in our own minds and the world, is a possible ideal. Science was born from the agreement of minds, and we are now regaining a larger unity by the path of diverse specialities all subserving the common good, and an incomparable richness of knowledge drawn together by similar methods of thought. What we need to reform our higher education in Great Britain—we must leave America to speak for herself—is a strong strain of scientific thinking among those doing mainly literary studies, and for those on the ‘science side’, a recognition that science and technology have also their history, that they are the fruit of time and of collective and continuous effort, and that their results must go back to enrich the human soil from which they sprang. F S MARVIN

### Short Reviews

*The Archaeology of Berkshire* By Harold Peake (The County Archaeologies) Pp xi+260 (London Methuen and Co, Ltd, 1931) 10s 6d net

MR PEAKE introduces us to his county with an apology. He points out that it possesses no monuments of outstanding importance—only two, the White Horse of Uffington and Wayland’s Smithy, are widely known—and there are no ancient sites of exceptional interest within its borders, Silchester, by the vagaries of county boundaries, being assigned to Hampshire. Yet an area which has the Thames as one of its limits, lies next to Wiltshire, the great centre of prehistoric interest, and includes geographically, if not administratively, one of the important cities of the Roman organisation, could scarcely fail to afford material of archaeological significance. In fact, it has produced evidence bearing on every period which falls within the scope of the “County Archaeologies”, from the earliest—two eoliths are said to have been found at Boxford—to the Norman conquest, when Abingdon was a monastic centre of importance and the county was fully occupied. On certain points, indeed, its archaeological material is of considerable moment such, for example, as the epipalæolithic culture of Thatcham, and the evidence from Wittenham and the neighbourhood, which shows continuous occupation through Romano-British and Saxon times. Questions of chronology depend upon the interpretation of the evidence of the terraced gravels of the Thames, but as Mr Peake says, these must be regarded as still open. A carefully compiled gazetteer gives details, with bibliography, of all the archaeological finds in the county, arranged under parishes.

The problem of setting out a coherent record of material, so much of which consists of isolated finds, is one of considerable difficulty. Mr Peake

has solved it happily by building up a picture of the succession of events through precise detail which conforms ultimately to a pattern determined by the geographical conditions of downland, river valley, and woodland. He has thus skilfully combined the interests of the specialist and the needs of the general reader—a perennial difficulty in a series of this kind, which must do its best to make the best of both worlds.

*Science and Common Sense* By John Langdon-Davies Pp 284 (London Hamish Hamilton, Ltd, 1931) 10s 6d net

MR JOHN LANGDON-DAVIES published a year or two back an interesting and stimulating book on “Man and his Universe”, of which the thesis was that the pursuit of science through the ages was the search for God. This was carried out by a sketch of the main steps in the evolution of science, and, being connected by the one master idea, it proved valuable to many lay minds who are perplexed by the intricacies and apparent *volte-faces* in present-day science. The second volume, which is now before us, attempts the more ambitious task of a philosophic survey of the whole field and discusses the relations of science with other branches of human thought, but, unfortunately, it does not take us very far. Aiming at being philosophical, it fails from want of philosophy. Where thorough and penetrating analysis is needed, it is content to put us off with superficial antitheses which lead to the devastating conclusion, often repeated, that “Reason as a leader of men is dethroned”.

The fundamental fallacy is developed in the earlier part of the book, where it is shown that, as we are unable to reach the nature of ‘things in themselves’, the only reality within our ken is that of the relations between phenomena which are knowable only in mathematical form. These form ‘reality’ for the rest of the volume, and all other experience—ideas of love, beauty, goodness—are dismissed as ‘make-believe’. The ‘make-believe’, we are led to conclude, have no substance, because they change from age to age or man to man. As if the conclusions of science were not equally liable on their own lines to evolutionary change! A more thorough analysis would give us a goal, real for all branches, though not attainable in its fullness, which is approached on converging lines in science, morality, and aesthetics. The lame conclusion of the book is a pity, because it begins with some excellent criticism of the tools of knowledge in our senses and language. But thoroughness and comprehensiveness in thought are often to seek in English books of this kind.

*Perkin and Kipping’s Organic Chemistry* Entirely new edition by Prof F Stanley Kipping and Dr F Barry Kipping Pp xi+614+xxix (London and Edinburgh W and R Chambers, Ltd, Philadelphia J B Lippincott Co, 1931) 8s 6d

It is nearly thirty-eight years since the first publication of this now world-famous textbook. This is its third complete revision, save for a partial one in 1922. Meanwhile its influence has become so

widespread that there is almost certainly not a single chemist under forty years of age in England who has not either studied direct from it or been taught by one who has

That the book has only needed complete revision, in spite of its enormous sales, three times during four decades of organic chemical advance is an indication of the genius and scientific foresight of the original authors. Would that more textbooks were so conceived

The sad reflection that one of the original authors, who approved in 1929 of this latest complete revision, did not live to see the work completed, is partly counteracted by noting that the son of the other author now collaborates with his father in bringing up to date one of the most valuable weapons in the hands of British chemists, a good textbook is surely no less than that. On the production side there is little to criticise, save the absence of a general title page for both parts and a combined list of contents at the beginning of the book.

Some of the greatest chemical advances of our time could doubtless be traced by comparing the 1894 and 1931 editions of "Perkin and Kipping". They would comprise whole areas of organic chemistry—the structure of the sugars and higher carbohydrates, the syntheses of polypeptides, investigations into the complex structures of alkaloids, sterols, and anthocyanins, the discovery of hormones and vitamins, and the steps taken towards isolating them and certain enzymes, indeed, these constitute but a small part of the investigations that will entitle the present century to be known as the age of organic chemistry. Perkin and Kipping should beyond a peradventure take no small part of that credit

A. L. B.

*The Science Masters' Book Part 1 Physics. Part 2 Chemistry, Biology, Conversazione Experiments.* Experiments selected from the *School Science Review* by a Committee of the Science Masters' Association. Edited and arranged by G. H. J. Adlam, with the assistance of W. H. Barrett, F. Fairbrother, T. Hartley, O. H. Latter, E. J. Moore, G. N. Pingriff, V. T. Saunders, E. G. Savage, A. Vassall. Part 1 Pp. xvi + 256. Part 2 Pp. xvi + 267. (London: John Murray, 1931) 7s. 6d. net each Part

THE provision of lecture experiments to illustrate and emphasise scientific teaching is a matter of great importance, and the Science Masters' Association, in producing these two books, has succeeded in filling a marked gap in the literature. The volumes have been built up from the notes on apparatus and experiments which have appeared from time to time in the *School Science Review*. Members of the Science Masters' Association have contributed many of the experiments, and a number have been selected from the demonstrations given at the annual meetings of the Association. In this work are to be found more than four hundred experiments, distributed over the different branches of physics, chemistry, and biology. The descriptions are excellent, and a commendable feature is that, in many cases, actual figures ob-

tained in the experiments show the reader what type of accuracy can be obtained. As appendices are given some very useful notes and experiments for conversazione use, also an excellent summary entitled "First Aid in the Laboratory", as well as information concerning the obtaining of duty-free spirit. The work is admirably balanced, well produced, illustrated with many diagrams, and is to be highly commended.

*Principles of Electricity an Intermediate Text in Electricity and Magnetism.* By Prof. Leigh Page and Prof. N. I. Adams, Jr. Pp. xii + 620. (London: Chapman and Hall, Ltd., 1931) 21s. net

To any student with a good knowledge of mathematics and physics, and desirous of obtaining a sound basis of the principles of electromagnetism, this book can be recommended. It is clearly written and the symbols used are sufficiently close to the international symbols to be readily interpreted. The authors have decided that magnetic induction  $B$  and magnetic intensity  $H$  are measured in the same units (the gauss). Thus the permeability is a dimensionless ratio. If all teachers in Great Britain would agree, this would simplify teaching.

To introduce symmetry into the fundamental equations, Lorentz and Heaviside suggested a system of units which the authors call the h l system. The h l unit of charge repels an equal like charge at a distance of one centimetre away with a force of  $1/(4\pi)$  dyne. We are told that the h l system of units is used almost universally by writers on electromagnetic theory at the present time. Future students will apparently have to learn not only the electromagnetic and the electrostatic systems of units, but also the h l system. We notice that 'capacity' is used and not 'capacitance'. We have difficulty in separating what the authors mean by 'proximity effect' from what they mean by 'skin effect'.

*The Secret of the Golden Flower a Chinese Book of Life.* Translated and explained by Richard Wilhelm, with a European Commentary by C. G. Jung. Translated into English by Cary F. Baynes. Pp. ix + 151 + 11 plates. (London: Kegan Paul and Co., Ltd., 1931) 12s. 6d. net

THIS is a most welcome contribution to an understanding of Chinese spiritism. The "Golden Flower" epitomises the Chinese vision of the secret of the powers of growth latent in the psyche; while Jung's striking commentary gives a transcription of these same powers as they reveal themselves in the Western mind. In brief, the "Secret of the Golden Flower" attempts to show that the spirit must lean on science as its guide in the world of reality, and that science must turn to the spirit for the meaning of life. This main theme is developed in the Chinese version with all the poetical and mystical characteristics of Eastern wisdom. The running explanations and notes of Richard Wilhelm, who first translated this work from the Chinese, throws much light on its meaning and value.

T. G.

## The Origin of the Solar System

A COPY of a paper published in the *Messenger of Mathematics* in March 1898, entitled "On the Oscillations of a Heterogeneous Compressible Liquid Sphere and the Genesis of the Moon, and on the Figure of the Moon", has been sent to the Editor of NATURE by Mr W F Sedgwick, who graduated from Trinity College, Cambridge, in the year 1894. Mr Sedgwick has also submitted the manuscript of an unsuccessful essay sent in by him for the Smith's Prize at the end of the year 1895 "On the Vibrations of a Heterogeneous Liquid Sphere, with Applications to the Solar System, and on the Elastic Solid Theory of the Earth". He states that the applications to the solar system on pp 170-171 of his published paper were based on considerations set out in much greater detail in his essay. His communications throw additional light on the history of ideas concerning the origin of the solar system. His paper has been generally overlooked in this connexion—not unnaturally, considering the somewhat distant relation between its subject and its setting—but there is no doubt of its relevance, and Sir James Jeans, in a letter to the Editor, remarks "I regret that Mr Sedgwick's work had entirely escaped my notice until my attention was recently directed to it. His theory of the origin of the solar system appears to have nothing in common with my own, except that both postulate tidal actions—of very different kinds. But I very gladly acknowledge that Mr Sedgwick's hypothesis of a tidal origin for the solar system was earlier than my own".

In view of the interest and importance of the question, the Editor considers that a general survey of the hypotheses which have been advanced to account for the existence of the planets is desirable, and he has asked me to make such a survey. Presumably the choice has fallen on one so ill-qualified because a few years ago (NATURE, April 13, 1929), in reviewing a book by the late Prof Chamberlin, it unexpectedly became my duty to comment on a controversy which had arisen in connexion therewith. Unwillingness to shirk any legitimate consequence of that review must be my excuse for accepting this further charge, but before proceeding with it there are three explanatory remarks which I wish to make.

First, this article is not to be regarded as the result of an exhaustive examination of scientific and quasi-scientific literature. It is simply an ordered account of material, most of which has been placed in my hands *ad hoc*. No claim on behalf of a hypothesis is more questionable than that of novelty. An idea which the author thinks original as likely as not proves aboriginal, and no experienced person would be unduly surprised if it transpired that modern ideas of the solar system were held by some mad precursor of Thales. If this article brings to light material so far overlooked, it will serve a useful purpose.

Secondly, no account is taken of other than published material. However strong the presump-

tion might be that ideas in a certain unpublished paper antedated similar ideas presented in a later published paper, it is still a presumption and is consequently ignored. For the same reason no attempt is made to judge of independence or otherwise of thought. The dates of presentation or publication being given, the reader can form his own opinion on such matters.

Thirdly, the material is presented without comment on its value. It is admittedly an important matter whether a criticism of, say, Laplace's nebular hypothesis, is a legitimate one or not, but it is a matter which must be left to others to decide. Similarly, it is an important matter whether a casual mention of an idea is entitled to priority over a slightly later thorough exploration of it, but that also must be left to others to decide. In brief, this article is nothing but a probably incomplete statement of facts relating to dates of publication of relevant matter.

According to Dr Harold Jeffreys (*Observatory*, 52, 173, 1929), Buffon's "Natural History" (1750) contains the suggestion that the prevalence of direct revolution among the planets might be due to the system having arisen from a grazing impact between the primitive sun and a comet. (By a 'comet', it should be said, Buffon understood something much more dense and massive than a comet as we now picture it.)

Five years later Kant, in his "Universal Natural History and Theory of the Heavens" (1755), gave another explanation, bearing strong resemblances to Laplace's later and more famous nebular hypothesis. There were, however, some important differences, among which, perhaps, the chief was that Kant imagined the angular momentum of the system to be developed during its evolution, whereas Laplace put the angular momentum among the original data.

Laplace's hypothesis, which was published in his "Exposition du système du monde" (1796), is too well known to need description. Its author does not mention Kant's work, but devotes a few lines to Buffon, whose suggestion he rejects.

On the whole, the nineteenth century was satisfied with Laplace's hypothesis, but there were some dissentients, as well as some supporters, who offered what, in view of later work, are interesting additions. Thus Croll (*Phil Mag*, May 1868, p 373, "Stellar Evolution and its Relations to Geological Time", 1889) conjectured that the original nebula which Laplace postulated might have been generated by the collision of two dark stars. Proctor ("Other Worlds than Ours", 1870), on the other hand, attacked Laplace's hypothesis and advocated the idea that the planets were built up by aggregation of meteorites. The revolt against Laplace was continued by Bickerton, who (*Trans New Zealand Inst*, 12, 193-194, 1879, and subsequent papers) substituted for the nebular hypothesis an idea, similar to Buffon's, of a grazing collision between two stars,

followed by the building up of planets by accretion of small bodies

The next idea appears to be due to Mr Sedgwick, who, in his paper in the *Messenger of Mathematics* (1898), referring to the birth of the initial planet and satellites, wrote "The initial satellite in each sub-system might be produced in the same manner as the moon on the hypothesis suggested" (that is, by tidal action of the sun coinciding in period with the natural oscillations of the primitive planets), "whilst the initial planet of the system might be caused by a similar, or different, agency in long distant periods", the "similar agency" being tidal action coinciding in period with the natural oscillations of the nebulous sun. Mr Sedgwick's earlier unpublished Smith's Prize essay cannot be considered here for reasons already stated.

On Aug 20, 1897, however, Prof T C Chamberlin, at the Toronto meeting of the British Association, gave an address on "A Group of Hypotheses bearing on Climatic Changes"—this was published as a paper in the *Journal of Geology* (5, 653-683, 1897). Chamberlin criticised the nebular hypothesis—in particular, the idea that the earth was originally molten or gaseous—and proceeded to "follow the hypothetical growth of a planet built up by the slow aggregation of small bodies which join it at low velocities and develop a minimum heat". This, so far as we can gather, was the primal germ of what later came to be known as the planetesimal hypothesis. Chamberlin, whose arguments are geological, makes no reference to the similar astronomical ideas of Proctor and Bickerton.

About three years later, Chamberlin (*Journal of Geology*, 8, 58, 1900) and, almost simultaneously, Prof F R Moulton (*Astrophysical Journal*, 11, 103, 1900) launched a more systematic attack on Laplace's hypothesis and concluded that it was definitely untenable. Chamberlin and Moulton were admittedly working in collaboration. Shortly afterwards, Chamberlin, in a paper published in the *Astrophysical Journal* (14, 17, 1901), and repeated in the *Journal of Geology* (9, 369, 1901), considered in some detail the consequences of a close approach of two stars to one another and showed that such an event might reasonably account for the existence of spiral nebulae, meteorites, and comets. No suggestion was made, however, that the solar system might have originated in this way. Moulton's help was acknowledged, and so far as objective evidence is concerned the position may be summed up by saying that at this time Chamberlin and Moulton were collaborating on problems of cosmogony, including in particular the origin of the solar system, and that the influence of two near cosmic bodies on one another was among the problems they considered. A casual remark in 1900 by Keeler (*Astrophysical Journal*, 11, 348) points to still more definite conclusions. Speaking of his studies of the spiral nebulae, he says

If the spiral is the form normally assumed by a contracting nebulous mass, the idea at once suggests itself that the solar system has been evolved from a spiral nebula, while the photographs show that the spiral nebula is not, as a rule, characterised by the

simplicity attributed to the contracting mass in the nebular hypothesis. This is a question which has already been taken up by Professor Chamberlin and Mr Moulton, of the University of Chicago.

It was not until 1904, however, that the embryonic planetesimal hypothesis actually came to birth. In the Year Book No 3 (pp 195-254) of the Carnegie Institution of Washington for that year (published in January 1905), Chamberlin, remarking that "a complete statement of the planetesimal hypothesis has not yet appeared in print", proceeded to supply one. His account reveals the hypothesis as primarily geological in character. Its central feature was the idea that the earth was built up by the aggregation of a large number of "planetesimals", the production of these bodies from solar matter drawn out by a passing star was an inessential subsidiary hypothesis. Chamberlin says

As the basis for developing the typical form of the planetesimal hypothesis, I have assumed that the parent nebula had a planetesimal organisation from the outset. To develop the hypothesis as definitely and concretely as possible, I have further chosen a special case from among those that might possibly arise, viz, the case in which the nebula is supposed to have arisen from the dispersion of a sun as a result of close approach to another large body. The case does not involve the origin of a star nor even the primary origin of the solar system, but rather its rejuvenation and the origin of a new family of planets. The general planetesimal doctrine does not stand or fall with the merits or demerits of this special phase of it, but to be of much real service in stimulating and guiding investigation, a hypothesis must be carried out into working detail so that it may be tested by its concrete and specific application to the phenomena involved, and hence the reason for developing a specific sub-hypothesis. This particular sub-hypothesis was selected for first development (1) because it postulates as simple an event as it seems possible to assign as the source of so great results, (2) because that event seems very likely to have happened, (3) because the form of the nebula supposed to arise in this way is the most common form known, the spiral, and (4) because spectroscopic observations seem at present to support the constitution assigned this class of nebulae.

From that time onwards the hypothesis has been developed in a succession of papers, its present state is described in Chamberlin's last book, "The Two Solar Families" (1928). The hypothesis of the passing star is there presented as essential to the theory, but the precise stage at which it attained that status does not concern us here.

Sir James Jeans seems first to have turned his attention to the problem in 1901. In that year he published (*Phil Trans*, A, 199, 1, abstract in *Proc Roy Soc*, 68, 454, paper received, June 15, 1901) a detailed consideration of an aspect of Laplace's hypothesis under the title "The Stability of a Spherical Nebula". At the end of this paper occurs the following passage

In conclusion, two particular cases of 'irregularities' may be referred to. If the nebula is penetrated by a wandering meteorite, at a moment at which it is close to a state of instability, the presence of the meteorite

will constitute an irregularity, and may easily result in the formation of a satellite. And if a quasi-tide is raised in the nebula by the presence of a distant mass, the same result may be produced.

The suggestion contained here made no further appearance until it had blossomed into the formal 'tidal theory'. In a paper received by the Royal Astronomical Society on Nov 3, 1916, and published in *Mem R A S*, 62, part 1, 1917, Jeans considered "the motion of tidally distorted masses, with special reference to theories of cosmogony."

In recent years [he wrote] the position of this hypothesis [Laplace's] has been challenged by speculations based ultimately upon the conception of tidal forces providing the required tendency to separation, the most complete and definite of these speculations being found in the Planetesimal Hypothesis of Chamberlin and Moulton. In the present paper I have attempted to follow up mathematically the changes in a mass of matter as the tidal forces acting on it continually increase.

As a result of the investigation the following conclusion was reached

The genesis of our solar system can very probably be attributed to tidal action, the explanation leaves room for a good deal of uncertainty in matters of detail, but does not demand anything impossible or very improbable. The evidence we have been able to obtain suggests that a system generated by tidal action might quite well have characteristics, both qualitative and quantitative, such as are observed in our system. The origin which seems most probable is not that of the planetesimal hypothesis.

Further developments—showing, like the planetesimal hypothesis, some modification of the original conjectures—are recorded by Jeans in "Theories of Cosmogony and Stellar Dynamics" (1919), Supplement to NATURE, March 1, 1924, and "Astronomy and Cosmogony" (2nd edition, 1929).

In *Ast Nach* 4308 (Jan 1, 1909), T J J See advanced the idea that the planets were not de-

tached from the primitive sun but were "captured, or added from without, and have had their orbits reduced in size and rounded up under the secular action of the nebular resisting medium" formerly pervading our solar system. The idea was further developed in "Researches on the Evolution of the Stellar Systems", vol 2, p 357, 1910.

Dr Harold Jeffreys discussed the planetesimal hypothesis in a paper in *Mon Not R A S*, December 1916 (77, 84). He considered that it was open to the objection that the planetesimals would be fused and volatilised by collisions, and so could not build up the planets by the slow aggregation postulated by Chamberlin. In *Science Progress* (July 1917) he outlined some considerations on the early history of the solar system which were developed more fully in *Mon Not R A S*, 78, 424, April 1918. Starting, like Chamberlin, from geological data, he came to the opposite conclusion, namely, that the planets were formerly liquid or gaseous. Dismissing the nebular hypothesis of their origin by an argument described as "a modification of that of Jeans", he turned his attention to the tidal theory.

This theory [says Jeffreys] forms part of the Planetesimal Hypothesis of Chamberlin and Moulton, its dynamical possibility has been proved by Jeans, and I have shown here and elsewhere [in *Science Progress*] that the system it would lead to would resemble our own in several striking features. It will be definitely adopted as a postulate in the present paper.

Jeffreys's further work is summarised in his book "The Earth" (2nd edition, 1929). The only subsequent development of significance here is the substitution (in *Mon Not R A S*, 89, 636, 731, 1929) of an actual collision for a close approach between the sun and the visiting star.

We end, therefore, where we began, the latest, like the earliest, known theory attributes our existence to the impact of another cosmic body on the primitive sun.

HERBERT DINGLE

### The History of Ergot

ERGOT has been under active scientific investigation for two generations, and has provided sociological problems for ten centuries, its secrets are now almost all laid bare, and at the moment when investigators are likely to turn aside from its study to that of other subjects, Prof Barger has come forward to write its biography.\* Usually a subject of so much interest attracts the notice of the mere collator, fortunately, ergot has not done so, and it has been left for the story to be written by a distinguished chemist, who may be congratulated on having sufficient imagination to realise how rich a story it could be. Few even of those who have worked on ergot would have guessed it.

The main importance of ergot in the past was not medicinal but as a cause of epidemic disease, instead of a healing draught, it was a scourge.

\* Ergot and Ergotism: a Monograph based on the Dohme Lectures delivered in Johns Hopkins University, Baltimore. By Prof George Barger. Pp xvi+279+6 plates (London and Edinburgh Gurney and Jackson, 1931) 15s net.

Strange as it may seem to us in Great Britain, "rye is still the chief cereal in a large belt of Europe extending from Holland across Northern Germany, Czecho-Slovakia, Austria, Poland, and Central Russia", and in Poland, for example, four times more rye is eaten than wheat. From the ergot present in the rye have come the many epidemics of ergotism.

Ergotism occurs in two forms, known respectively as gangrenous and convulsive, in the first form the symptoms are due to the effect of ergot on the blood vessels, as a result of which the blood supply to the extremities is cut off, so that gangrene occurs and the limb drops off, loss of the leg below the knee is common. Convulsive ergotism, on the other hand, is not an affection of the blood vessels, but of the central nervous system, it is characterised by the appearance of areas of degeneration in the spinal cord, and the symptoms are convulsive seizures.

The distribution of the two forms of ergotism has long been a mystery, which Prof Barger has now solved by the light of the recent work of E Mellanby in Sheffield. For example, about 1770 there was an epidemic of gangrenous ergotism in Sologne on the left bank of the Rhine, while in Hanover on the right bank there was an epidemic of convulsive ergotism. Why should there have been so sharp a difference in the symptoms in the two localities? Now Mellanby has shown that convulsive ergotism is readily produced in dogs which are given one or two grams of ergot daily, provided that the diet is free from vitamin A, but the same amount of ergot produces no harmful effect if vitamin A is added to the diet. Prof Barger points out that the difference in the 1770 epidemics in Sologne and Hanover fits in admirably with this work, Sologne was a dairy-farming district where the inhabitants had milk and butter, the vitamin A present in the diet prevented the appearance of nervous symptoms. In Hanover, on the other hand, the soil was very poor and unable to support cattle, so that the peasants had little save rye to eat, in consequence the nervous type of ergotism appeared.

Records of gangrenous ergotism go back to A.D. 857, when the "Annales Xantenses" state that a great plague of swollen blisters consumed the people by a loathsome rot, so that their limbs were loosened and fell off before death. The early approach of the disease is marked by a feeling of intense heat in the part affected, and this was responsible for the name 'holy fire', which during the twelfth century became associated with St. Anthony, when many sufferers began to visit the saint's relics preserved in an abbey near Vienne in Dauphiné. There was a hospital attached to the abbey, and the sick either died within seven days of their arrival or were 'miraculously' restored to health by the wholesome food they received there. The historical details which Prof Barger has collected make fascinating reading of a kind which is only too rare in modern scientific monographs, we learn how ergotism even prevented a military campaign in Russia in 1723.

The history of the introduction of ergot into medicine is also surprising, the earliest mention of its use as a drug is in the 1582 edition of Adam

Lonicer's "Kreuterbuch", but its real entry into official medicine took place in the United States. "In the Medical Repository of New York there appeared in 1808 an 'Account of the Pulvis parturiens, a Remedy for quickening Child birth', in the form of a letter from Dr John Stearns of Saratoga county to Mr S Akerly." The method of administration was either in decoction or in powder. "It expedites lingering parturition and saves to the accoucheur a considerable portion of time."

Prof Barger's monograph includes also botanical, chemical, pharmacological and clinical, pharmaceutical, and forensic sections. While Tanret in 1875 was the first to isolate one of the ergot alkaloids in crystalline form, this substance, ergotamine, is inactive, and Prof Barger himself, together with Dr F H Carr, was responsible in 1906 for the isolation of ergotoxine, which is almost certainly the more important of the two active alkaloids. All four alkaloids, ergotamine, ergotoxine, ergotamine, and ergotaminine, have recently been obtained in crystalline form by S Smith and G M Timmis, and are known to be separate chemical individuals. Ergotamine has the formula  $C_{35}H_{39}O_5H_5$ , while ergotamine and ergotaminine are isomers having the formula  $C_{33}H_{35}O_5N_5$ . Only the formula of ergotoxine remains in doubt, the probability being that it is also isomeric with ergotamine. There remains the puzzle of the occurrence of ergotamine, the active alkaloid isolated by Stoll, for no other worker has obtained ergotamine from ergot of rye, the claims of Forst to have done so being open to doubt. Smith and Timmis readily obtained ergotamine from the ergot of *Festuca elatior*, but failed to do so from any of the many samples of ergot of rye which they examined. Stoll's statement that ergotamine is present in ergot of rye is, therefore, lacking in confirmation.

Prof Barger's book, in its completeness and in the care taken in its presentation, is a work of art, it is a model which should inspire others, particularly those interested in pharmaceutical science, to attempt to do the same for other drugs. One imagines that among the pharmacists the book has created a sensation, which will provide them with eager discussion for some months to come.

## Obituary

PROF. E. WILSON

THE sudden death on Feb 17 of Prof Ernest Wilson, emeritus professor of electrical engineering and fellow of King's College, London, came as a shock to his many friends and caused a widespread feeling of loss in scientific and engineering circles. Though frail in appearance, he possessed a vitality which was the envy of his numerous friends, together with an engaging personality and a devotion to duty exhibiting the utmost selflessness, which endeared him to students and all with whom he came in contact.

Born in Lincolnshire, on Nov 25, 1863, he joined the works of Messrs. Greenwood and Batley,

Leeds, where he served his time as a six-o'clock lad, learning some of life's lessons, as well as laying a solid foundation for his life's work. It is interesting to note that while at this works he was engaged on the construction of the first Brush machine and the first Ferranti alternator made in England.

Making the most of his opportunities and attending technical classes at the Yorkshire College, Wilson secured a Whitworth scholarship, which enabled him to proceed to Germany, 1886-87, and take up further studies and gain engineering experience. During his study of electro-technology in Germany, he assisted Prof Kohlrausch



in making elaborate tests on an early Lahmeyer dynamo with the object of verifying Dr Frolich's theory of the dynamo

Afterwards, Wilson became a draughtsman in the Woolwich works of Messrs Siemens Brothers, where he was largely responsible for much of the pioneer electrical work and progress of that firm. While at Woolwich, he attended evening classes at Finsbury Technical College, where he came under the influence of John Perry and Silvanus Thompson. He was appointed assistant to Dr John Hopkinson at King's College in 1890, and, following the tragic death of Hopkinson, in 1898 he was appointed to the chair of electrical engineering, from which he retired in 1930, after forty years of devoted service as a teacher and friend of hundreds of students

Early in his career Wilson encountered a multitude of problems which then confronted electrical engineers, such as the design of the electric motors to be used on the three-wire system for the first locomotives for the City and South London Tube Railway. This experience led him to write "Electrical Traction", published by Edward Arnold in 1897. The second edition of this book, long recognised as a standard work on the subject, was written in collaboration with Mr F Lydall and appeared as two volumes in 1907.

Although engineers are slow, as a rule, to take up the pen, Wilson proved to be an exception, for he was a prolific writer. From 1892 on, he contributed no less than eighty papers of his own, and about thirty of joint authorship, to the *Philosophical Transactions* and *Proceedings of the Royal Society*, *Proceedings of the Physical Society*, numerous technical journals, and to the British Association. His first paper to appear in the *Journal of the Institution of Electrical Engineers*, vol 26, 1897, dealt with the "Relative Size, Weight, and Price of Dynamo Electric Machines", and his first contribution to *Engineering*, in 1891, dealt with the electric lighting of the Royal Naval Exhibition (1891), where his control switch for the manipulation of searchlights was shown in use.

Besides assisting in joint experimental work with Hopkinson, Wilson engaged in many researches, he worked in the fields of alternating current instruments, radio telegraphy in its early phases, the magnetic properties of iron and various alloys, and especially studied the properties of aluminium and its alloys with reference to conductivity and deterioration. He published a number of papers on magnetic shielding and the susceptibility of feebly magnetic materials. One of his earliest inventions was that of the laminated-field single and polyphase alternating-current commutator motor in 1888 (British Patent 18,525), and his original machine is to be seen at the Science Museum, South Kensington. On being requested to do so by Sir William Preece, he carried out the first tests of Marconi's wireless apparatus on the terrace at King's College, and, so far as the writer is aware, gave a favourable report on the possibilities of the new device.

The Institution of Electrical Engineers awarded

Wilson the Kelvin Premium in 1921, and, so recently as last year, a premium for his paper, "The Electrical Conductivity and Tensile Properties of Light Magnesium-Aluminium Alloys as affected by Atmospheric Exposure". He was elected a member of the Council of the Institution in 1929, thereafter taking an active part in the proceedings of its committees.

Wilson took a leading part in the development of the faculty of engineering of the University of London, and was a member of the various boards of the University until his retirement.

Possessing a retiring and modest nature, Wilson made little effort to bring himself or his work before the notice of the public or even of the engineering profession, but, on the other hand, few teachers could claim so large a circle of friends or so sincere a regard as that in which he was held. He had known many of the pioneers of electrical engineering and he had an almost unrivalled store of information about early experiments and the whereabouts of original pieces of apparatus, and his advice was always sought whenever such information was wanted.

Since his retirement from the William Siemens University chair of electrical engineering at King's College, London, in 1930, Wilson devoted himself whole-heartedly to the arduous task of advising engineer students, both past and present, as to their best way of securing employment. In this he was highly successful, and last year he assisted so many as one hundred young men to obtain posts in engineering work. Wilson leaves a widow, a son, and a daughter.

J K C-S

#### DR W D DYE, F R S

AFTER a very short attack of pneumonia following influenza, there passed away on Feb 18, at the early age of forty-four years, an unusually brilliant experimenter in the person of Dr W D Dye. After being educated at Portsmouth and the City and Guilds Technical College, Dye was appointed a student assistant at the National Physical Laboratory. At that time, Mr Albert Campbell had completed his well-known standard of mutual inductance and was engaged on very precise comparisons of resistance with mutual inductance. Other work engaging Campbell's attention was an evaluation of the ohm by an alternating current method, and a study of experimental methods for the measurement of the length of wireless waves.

In this atmosphere of high precision alternating current measurement, Dr Dye soon became at home. He noted, with some surprise, Mr Albert Campbell's love of making, with his own hands, small and delicate instruments like thermocouples and galvanometer suspensions, and quickly acquired similar skill. Indeed, in this direction, he delighted to do what many others thought to be impossible. He made up his mind very quickly, and when an experiment failed to give results of immediate service, he abandoned it rather than modify small details. Alternative methods for achieving results came to his mind very quickly, and not infrequently he would scrap one method

and have an alternative one worked out within a few hours

After the War, Dr Dye succeeded Mr F E Smith, now Sir Frank Smith, as head of the Electrical Standards Division, and established his reputation for highly accurate work in the measurements he carried out on the primary electrical standards and units, including standards of inductance and capacity. He devised a new method for accurate measurement of the vertical component of the earth's magnetic field, and the apparatus he constructed for this purpose is now the principal instrument in regular use for absolute measurements at the Abinger Magnetic Observatory. More recently he had devoted himself to the development of new methods of time measurement for precise standardisation of radio frequency, and had already achieved results of a very high order, using a specially controlled tuning-fork and a quartz oscillator. He was a member of the Radio Research Board and of the British National Committee of the Union Radio-Scientifique Internationale, of which he was secretary, and at the Congresses at Washington, Brussels, and, last year, at Copenhagen, he acted as chairman of the Commission on Radio Standards. He was elected a fellow of the Royal Society in 1928, and was a member of the Council of the Physical Society

#### SIR ARTHUR DUCKHAM, G B E, K C B

THE death of Sir Arthur Duckham, which occurred with tragic suddenness on Feb 14, is a great loss to the nation. He stood in the forefront of British industries and, at the age of fifty-two years, in the fullness of his powers, seemed destined to play a great part in the campaign that lies before our industrial leaders. Trained as an engineer under the enlightened regime of Sir George Livesey at the South Metropolitan Gas Company's works, Arthur Duckham evinced at an early age the inventive skill, enterprise, and energy which bespoke a great future. In conjunction with Col H W Woodall at Bournemouth, he brought to success the well-known Woodall-Duckham process for the continuous carbonisation of coal in vertical retorts. From this achievement he passed to other work connected with furnace construction and carbonisation, and built up the great organisation

of Woodall-Duckham enterprises, of which he was the leading spirit.

Duckham's labours extended widely beyond this commercial enterprise. Early in the War he was brought into action in connexion with munitions supply and, by his exceptional gifts, soon attained a leading position in this exacting and vital work. His services were recognised by conferment of K C B in 1917. He was a member of the Sankey Coal Commission in 1919 and, in an individual report, favoured State ownership of mineral rights but not of mines. In 1928 he spent seven months in Australia as chief of a small commission of English industrialists appointed to advise on trade opportunities with that country. Further recognition of his public services was marked by the conferment of G B E in 1929.

Duckham had a full appreciation of the part to be played by science in modern industry. Without extended formal scientific training, he had the scientific instinct and outlook. In his own business he had an elaborate and highly efficient scientific intelligence service which secured all necessary aid for his various enterprises. He was ever ready to plead the cause of science, and he had occupied the presidential chair of the Institution of Chemical Engineers and the Society of British Gas Industries. He was president-designate of the Federation of British Industries for 1932.

Sir Arthur Duckham was endowed with qualities of character and temperament which, in all walks of life, made an instant appeal and secured for him a quite exceptional measure of regard. His loss will be felt as a personal bereavement throughout a very large circle.

#### WE regret to announce the following deaths

Sir Frederick William Andrewes, F R S, emeritus professor of pathology in the University of London, a pioneer of bacteriology in Great Britain, on Feb 24, aged seventy-two years.

Dr George Claridge Druce, F R S, curator of the Fielding Herbarium in the University of Oxford, on Feb 29, aged eighty-one years.

General G Ferrié, formerly president of the Committee on Longitudes of the International Astronomical Union, on Feb 16, aged sixty-three years.

### News and Views

#### Prof A. W. Williamson and Japanese Development

MUCH attention is being given at present to affairs in the Far East, in connexion with which it is of interest to recall the pioneer efforts of nearly seventy years ago of Prof Alexander W. Williamson, F R S, the distinguished chemist, to enable Japanese youth of high rank to obtain a knowledge of European methods in education, the arts and sciences, commerce, and manufactures. In association with him was a small band of men, inspired by his enthusiasm and example. Williamson was born at Wandsworth in 1824, and he died in 1904. Educated mostly abroad, he was a

pupil of Gmelin, at Heidelberg, and Liebig, at Giessen. In 1849 he was elected professor of practical chemistry at University College, London, with which the chair of general chemistry was later (1855) combined; he remained in the service of the College for thirty-nine years. Williamson was foreign secretary of the Royal Society from 1873 until 1890, and a Royal medallist of that body. On two occasions he was chosen president of the Chemical Society.

THE opening for Williamson's scheme came in 1863, when he received, through a London merchant having trading connexions in the Far East, an offer to send

him five Japanese youths to be housed and started in educational courses akin to English ideas and outlook. Thereupon Williamson undertook the necessary supervision, and he discharged his responsibilities thoroughly. It is sufficient to mention the after careers of these students of English methods to show this. One, who became the Marquis Ito, framed, in course of time, his country's constitution, a second, afterwards Count Inouye, aroused and developed commerce, a third, Viscount Inouye, inaugurated the Japanese railway system, a fourth, Viscount Yamao, became the first Minister of Public Works, and initiated a scheme of technological training, assisted by workers drawn from British sources. In all this early planning Williamson had a share, through his disinterested activity. The first contingent of youths was followed by a party of sixteen from Tokyo, sent by the Prince of Satsuma, also placed under Williamson's watchful eye. Among these were Mori, Yoshima, and Sameshima. Finally, just over half a century ago (1880), we find Williamson engaged in a research with Sakurai, the Japanese chemist, and others of his nationality.

#### Imported Scientific Films and Museum Specimens

By the Finance Act of 1925, a customs duty of 33½ per cent was placed upon films imported into Great Britain. During the debate on the Finance Act of 1928, Capt Ian Fraser, M.P., moved an amendment exempting from duty "cinematograph films . . . certified by the Royal Society of London for promoting Natural Knowledge to be solely an illustration of scientific investigation for exhibition before members of a recognised scientific body and imported only for the purpose of such exhibition free of charge". This amendment was accepted, and proved to be a small but much appreciated boon to scientific workers and others, who obviously benefit by the free international exchange of films recording their investigations. The new Import Duties Bill did not include such films in its list of imports exempt from duty, and Capt Fraser put down an amendment the object of which was to retain the privilege. This amendment has now been taken over by the Chancellor of the Exchequer as an official amendment, and was incorporated in the Bill on report stage on Feb 25. In a letter in the *Times* of Feb 27, Sir Henry Wellcome refers to the position of material for exhibition in museums. A clause has been added to the Import Duties Bill exempting such material when it is more than a hundred years old, but this will not cover natural history, ethnographical, and other specimens required by research workers. The Museums Association, in a letter from its honorary secretary, Mr D W. Herdman, has endorsed Sir Henry Wellcome's statement, adding that its views have already been communicated to the Chancellor of the Exchequer. Museum material is clearly on the same footing as printed books, and we hope that it will be possible similarly to exempt it from import duty.

#### Prof C. V. Boys's Apparatus at the Science Museum

PROF C V BOYS has recently presented to the Science Museum, South Kensington, some very interest-

ing examples of his early experimental work. His use of quartz is shown in one case, where the bow which he employed in 1889 in the preparation of quartz fibres by the well-known 'bow-and-arrow' method is exhibited, together with examples of arrows used with it. Several of the fibres made by him in this way are exhibited, as well as the first quartz bulb ever blown. Soon after his successful production of quartz fibres, Prof Boys utilised this material in an attempt to determine the constant of gravitation with a modified form of the Cavendish apparatus. He showed that increase of sensitivity could be accompanied by a considerable reduction in size, thus greatly reducing convection troubles. A small experimental apparatus made in 1889 served to demonstrate that consistent and accurate results could be obtained in this way, and as a result of the experience thus gained, a somewhat larger apparatus was made and used between 1889 and 1894 for the determination of the gravitational constant. Both instruments are now exhibited together, and form a permanent record of Boys's classical determination of this most important constant. In addition to the above, the following pieces of apparatus due to Prof Boys are also on exhibition: the original experimental radio-micrometer, a portion of a new form of difference engine, and two electrometers, both dating from about 1891.

#### Scientific Research at the British Museum

By the establishment in April 1931 of the Research Laboratory at the British Museum as a permanent institution under the control of the Trustees, the experimental stage of the undertaking, which had been continued by the Treasury and the Department of Scientific and Industrial Research for no less than eleven years, was brought to a successful conclusion. In a paper read before the Royal Society of Arts on Feb 24, the Director of Scientific Research, Dr Alexander Scott, indicated the nature and variety of the work carried out in his laboratory and described some of the results which have been obtained. In discovering the best means of restoring and preserving museum objects, it is essential first to learn all that is possible regarding the previous history of each specimen, neglect of this essential has, in the past, led to many failures and has earned scientific men an evil reputation. The establishment of the research department on a permanent basis, however, is clear proof that the custodians of the nation's treasures have confidence in the methods which have been devised with so much care and applied with so much success.

#### Restoration and Preservation in Museums

DR SCOTT referred to the disintegration of stone objects arising from the crystallisation of salts contained in the porous material, and to the extraction of the salts by means of wet paper pulp, salts are also removed from fragile brick tablets by first applying a celluloid coating, and then diffusing the salts into distilled water. Stains on old manuscripts can frequently be removed by the application of pyridine, and brown marks on water-colour pictures by the application of a solution of chloramine-T. The treatment of 'bronze

disease', a condition due to the presence of chlorine, by soaking in sodium sesquicarbonate solution followed by copious washing will often remove all the chlorine without attacking the patina, whilst in aggravated cases, soaking in citric acid solution or the use of an electrolytic process may be necessary. Fourteenth century glass from Wells Cathedral was found to be coated with material derived from the combined action of an impalpable powder arising from the limestone floor and sulphuric acid provided by the combustion of gas. Other problems the successful solutions of which were described by Dr Scott included the corrosion of a silver chalice, the unrolling of a manuscript on fragile leather, and the cleaning of marble busts.

#### Chemical and Photochemical Reactivity

ON Dec 17, 1931, the Chemical Society devoted an ordinary scientific meeting to a discussion on the critical increment of homogeneous reactions. It was immediately apparent that the material then presented and the observations then offered should be put on permanent record in an accessible form, and this has since been done by the publication of a separate pamphlet (1s 6d) bearing the imprint of the Society and following the form of its *Journal*. The discussion was opened by Mr C. N. Hinshelwood, whose subject was the energy of activation of chemical reactions. The magnitude and nature of activation energy, catalytic phenomena, and the contributions of quantum mechanics to the problem were among the matters considered. Mr E. J. Bowen followed with a paper on photochemistry and chemical reactivity, referring to photosensitisation, the phenomenon of 'predissociation' discovered by Henri, and the direct reaction of excited and normal molecules. Prof. A. J. Allmand's contribution dealt with the variation of quantum efficiency with wave-length in photochemical reactions, five different types of effect are distinguished, and their incidence in affecting the quantum yield was examined. Prof. E. K. Rideal discussed transition reactions, while Dr F. G. Soper gave an account of researches on the effect of solvents on reaction velocity. Dr. T. Iredale communicated a short contribution dealing with the heat of activation of hydrogen iodide. In the spontaneous discussion which followed, Dr R. G. W. Norrish, Mr C. R. Bailey, Prof. Allmand, Mr H. W. Thompson, and Mr Hinshelwood took part. Their observations, together with the full text of the principal contributions, are to be found in the publication already mentioned.

#### Preservation of the Fauna of the Empire

IN a short address at the general meeting of the Society for the Preservation of the Fauna of the Empire, the chairman, Sir Peter Chalmers Mitchell, made a strong appeal for the consolidation of the position in regard to animal reserves within the Empire. At present the continued existence of faunal reserves depends upon the goodwill of individual governments or individual parliaments. The discovery of mineral deposits, the demand for timber, and other possible eventualities, may lead to particular

reserves being thrown open to traffic or trade, with disastrous effects to the animal population, which cannot be herded into new areas at the will of man. What is needed for the permanent protection of those faunas, which are rapidly becoming relic faunas, is the raising of the status of their native territory in certain cases from temporary reserves to permanent national parks. The Society, which since its foundation has worked so strenuously on behalf of the Empire's threatened animals, has often appealed, with reasoned arguments founded upon the reports of its own observers, to the Colonial Office, but so far without success. The alteration would involve no extra expenditure, ultimately, indeed, the national parks by proper administration would bring in a certain amount of revenue, the surplus earned by the Game Department of Kenya, under strictly regulated conditions, was £15,022 in 1930. At present their creation would cost nothing, and would mean permanent security for the animals and plants in the reserved regions.

WE strongly commend the campaign which the Society has launched for the spread of news relating to wild life. A short time ago we read in a northern newspaper an account of life in the forests of British Guiana, and the article was to be followed in the course of a few days by a lecture. It is excellent propaganda, the educational value of which must be appreciated by everyone interested in Nature and its preservation. The Society has in all 867 members; it deserves and ought to have many more. May we suggest that somewhere, say on the blank cover of the *Journal*, from the December number of which we have quoted, a note should appear of the conditions of membership and of the amount of the annual subscription.

#### Frequency Range of Broadcast Receivers

IN opening a discussion on the selectivity of broadcast receivers at the Institution of Electrical Engineers on Feb 24, Prof. C. L. Fortescue said that as the apparatus tested becomes more and more sensitive, components of higher and higher frequencies are found in it. The female voice is known to have components having frequencies so high as 10,000, and footfalls, hand-clapping, and the operation of typewriters are observed to have components of frequencies approaching 16,000. In broadcast transmitters provision is not usually made for such a wide range, and nearly every receiver has a much more limited range. A lower frequency limit of 50 and an upper limit of 5000 are usually considered to give good results. In the production of talking films, the audio-frequency output is, perhaps, subjected to the most careful scrutiny. In this case there is a noticeable tendency to try to get a full response up to a frequency of 10,000.

THE problem of getting uniformity of response over the whole audible range is more difficult. A highly trained observer detects, at particular frequencies, increases or diminutions in the loudness which the ordinary person does not notice. 'Musical' people are sometimes even the least critical of all in this

respect, owing to their peculiar power of imagining all the missing parts, just as in an ordinary telephone conversation the listener himself occasionally provides as much as fifty per cent of the intelligibility. It was mentioned that there is a good deal of evidence to show that many receivers accept high-frequency energy over a far wider range of frequency than is necessary. The result is that they suffer from serious interference, as the waves of transmissions on neighbouring frequencies and the programmes they carry are also heard. It would obviously be better to limit the high-frequency range. The question of whether the average purchaser of a broadcast receiver can be entrusted to get the best results from a sharply tuned high-frequency circuit is one that can only be settled by statistics.

#### Fisheries of the Thames Estuary

IN a note in *NATURE* of May 11, 1927, attention was directed to the unpublished reports of Dr James Murie on the Thames Estuary fisheries. Before his death in 1925, Dr Murie had published the first part of his "Report on the Fisheries of the Thames Estuary", containing Sections 1 to 3 and the greater part of Section 4. The second part, consisting of a large folio volume now in the Southend Public Library, was not published. Part of this is in galley proof, but the sixth section is in manuscript, and was written probably between 1895 and 1912. It was found in 1926 in an outhouse of Dr Murie's cottage at Leigh, and consisted of a sodden mass of paper. The sheets were carefully separated, dried, and transcribed by the Borough Librarian, Mr Pollitt, and a digest of this unpublished section is embodied in a long article by Mr A. Laurence Wells, published in the *Southend Standard* (Jan. 7 and 14, 1931), entitled "Special Thames Estuary Fisheries". The matter is full of interest and covers a wide field. It consists mainly of detailed notes on the various fisheries in the Thames Estuary, especially those relating to the Leigh fishermen, and embraces the history of many of the older industries and the methods employed, both ancient and modern. These carefully collected data about each individual fishery are of historical value. Many of the methods are now obsolete, but most of the fisheries themselves are still flourishing.

WHITEBAITING is a comparatively recent industry among the Leigh fishermen. Some two hundred years ago it was practised up the river beyond Blackwall, but pollution of the water has driven the whitebait more to the Thames mouth, where the fishing is principally carried on. At first they fished only in spring, then in the original season from February to August, now they fish throughout the year. Shrimping, on the other hand, is an industry of long standing, begun about a hundred years ago. Starfish dredging used to be profitable, now it is almost extinct. The five-finger star is a great enemy of the oyster, and in dredging for them the fishermen not only helped the oyster but also utilised the starfish by selling them to the farmer for manure. Now, however, owing to chemical manure, the farmer no longer wants them. Other enemies which are much dreaded both by the

whitebaiters and the shrimpers are the jelly-fishes and ctenophores, known by them as 'flat gall' and 'nut gall'. These come swarming from the sea during April and May, clogging the nets so that a continual and wearisome sorting is necessary. This manuscript is an important addition to the literature concerning the Thames Estuary fisheries, and all workers on the subject are indebted to those who have made it available to the public. Although containing about 22,000 words, it is obviously unfinished, for further sections were indicated consisting of notes on many other specialised forms of fishing.

#### Geodesy in India

THE Geodetic Report of the Survey of India, vol. 6, deals with the very varied and extensive work done during the period Oct. 1929–Sept. 1930. A regular latitude variation programme has been started, supplementing the regular longitude observations, and in due course will throw light on the existence or otherwise of crustal drift. The irregularities in the longitude results remain unexpectedly large. To improve the time-keeping, a Shortt clock has been obtained. The form of the geoid in India and the gravity work have now brought irrefutable confirmation of Burrard's Hidden Range, which at first was inferred from rather scanty deflexion data; the Hidden Range is found to be flanked on both sides by troughs. Again, the levelling results obtained in Bengal during the last seventy years have been discussed. The closing errors of the various circuits are found to be surprisingly large, much greater than should occur in the class of levelling explained. It appears that they can be simply and naturally explained by supposing that real changes of level have occurred. Parts of the alluvial plains of northern Bengal and Bihar seem to have been rising at the rate of one foot in twenty years; tidal records indicate that Calcutta is not sinking, so that the country farther north is presumed to be rising. Further, tidal predictions for the Indian Ocean have been published in a new and cheap form of greatly increased scope, on lines similar to those of the Admiralty Tide Tables.

#### British Museum (Natural History) Acquisitions

AMONG the recent acquisitions by the Department of Zoology are two important gifts from the Rowland Ward trustees, namely, the skull and horns of a fine specimen of the giant sable antelope from Angola and a group of the little ant-eater from northern Brazil. A valuable collection of birds has been received from Mr R. E. Moreau, secretary and librarian of the East African Agricultural Research Station at Amani, Tanganyika Territory. This collection, which was made by the aid of a grant from the Godman Exploration Fund, consists of some four hundred specimens belonging to about two hundred species, of which eight appear to be new to science. Acquisitions in the Department of Minerals include a large block of granite showing quartz-porphyry and a vein of apatite, from Penryn, Cornwall, presented by Mr. Ernest H. Davison, samples of platinum ore from Southern Rhodesia, presented by the director, Geological Survey of Southern Rhodesia, and specimens from

other regions. A model of the largest platinum nugget found in the Urals and crystals of sylvanite (sulpho-vanadate of copper) from Utah have been purchased. The herbarium of the Royal Botanical Society of London has been presented by the Council to the Department of Botany. A valuable collection of about eleven thousand European mosses has been presented by the Rev P G Rhodes, and Mrs T G Elliott has presented about four hundred specimens of Ceylon ferns collected by her father, the late Rev E N Freeman. The latter is of special interest as being the first large collection of localised Ceylon ferns received by the Department.

#### Hippophagy in Ancient Palestine

AN interim report from Sir Flinders Petrie on his excavations at Tell-el-Ajjul in southern Palestine, in the *Times* of Feb 24, dwells on the significance of the exploration of this area for the history of the Hyksos domination in Egypt and Palestine. "The south of Palestine", it is said, "proves to be the best source for understanding this great catastrophe of ancient times." The date of the city is now fixed by scarabs of Apepa I and the names of other Hyksos kings. The work of this season has brought to light a new custom. It will be remembered that last year the remains of a horse were discovered in one of the large pit-graves on the plain below the tell. The horse was disposed in the centre, while the bodies of the members of the family lay on shelves around the pit. Now the remains of a horse have been discovered which had evidently been sacrificed and its body buried under the foundations of a large building. Near by an oven had been built for the purpose of cooking the thigh and shoulders of the victim for a feast, while another horse had been completely cut up and the bones left on the ground after it had been eaten. Sir Flinders Petrie adds the interesting comment that no other example of hippophagy has been found in the east, and in the west the practice is not known later than the stone age.

#### Prof W. E. Garner

THE course of lectures on detonating substances which was to have been given at the Royal Institution on March 1, 8, and 15 by Prof W E Garner, Leverhulme professor of physical chemistry in the University of Bristol, has been postponed owing to an accident to him. Prof Garner has been engaged for some time in a research on solid explosive substances. On Thursday, Feb 25, when he was about to remove a crystal of pure lead azide from a cardboard pill-box containing about 5 mgm of the material, as he raised the cover of the box with his right hand, the material exploded. Two of his fingers were seriously damaged and his left hand received lesser injuries. We are glad to learn that he is making very satisfactory progress.

#### French Exploratory Voyages

A USEFUL chart of the world showing all the great French voyages of exploration from the fifteenth to the early nineteenth century is included in the issue of *La Géographie* for July-August 1931. The

chart, originally prepared by M H Roussilhe and L Bergelin for the Exposition Internationale d'Anvers in 1930, is based on the original itineraries and charts of the voyages concerned, and though on a comparatively small scale, is remarkably clear. An old-world appearance is given to it by various reproductions of vessels of the periods of different voyages, taken from contemporary sources and suitably placed on the oceans.

#### New Land Speed Records

ON Feb 24, at Daytona, Florida, Sir Malcolm Campbell set up a new record for land speed in his car *Blue Bird*. On two runs, northwards and southwards respectively, over a measured mile, his average time gave a speed of 253.968 miles an hour, thus beating his own record made last year at the same place and in the same car by about eight miles an hour. Sir Malcolm made a further attempt on Feb 26, but his speed over the measured mile was returned as 251.748 miles an hour. His average for five miles, however, worked out at 242.751 miles an hour, thus beating his own previous record for this distance by more than thirty miles an hour. Sir Malcolm's car *Blue Bird* had been fitted with a new and more powerful Napier engine of approximately 1500 h p.

#### Muslim Association for the Advancement of Science

THE objects of this Association, which was inaugurated at Aligarh about a year ago, are to stimulate research work amongst Mohammedans by means of grants in aid of special laboratory apparatus, research materials, and laboratory assistance. The Association is undertaking the publication of specialised memoirs by distinguished investigators in its *Proceedings*, and its constitution permits the creation of research professorships and visiting lectureships as soon as sufficient funds become available. Nawab Masood Jung, vice-chancellor, and Dr R F Hunter, the present holder of the Nizam chair of chemistry in the Aligarh Muslim University, are the first president and vice-president respectively, but the Association's constitution has now been extended to include representation on its council from British India, Hyderabad, and Egypt.

#### The Hayden Memorial Gold Medal

IT is announced that the Academy of Natural Sciences of Philadelphia has awarded the Hayden Memorial Gold Medal for 1932 to Dr Reginald Aldworth Daly, Sturgis-Hooper professor of geology in Harvard University. This is the outstanding American award for pre-eminence in geological and palaeontological research. Prof Daly's work chiefly involves the study of igneous rocks, their genesis, and the mechanics of their intrusion into the mountains of the earth. Other of his outstanding contributions to geology are his glacial-control theory of coral reefs, his work on the eustatic shift of oceanic level, and his researches on the constitution of the earth. He has presented many of his ideas in popular form in his book, "Our Mobile Earth" (1926). The Hayden award, which is made every three years, was founded in 1888 by Mrs Emma W Hayden, of Philadelphia, as



a memorial to her husband, Dr Ferdinand V Hayden, director of the United States Geological and Geographical Survey in the early days of that organisation

#### Botanic Gardens in South Africa

IN Part 17 of the *Journal of the Botanical Society of South Africa* (1931) is published an excerpt from the report written by Sir Arthur Hill to the Union Government after his tour in South Africa in 1929, which was referred to in NATURE of Feb 7, 1931, p 217. The report states that at present, owing to lack of funds, the Director of the Kirstenbosch Botanic Garden is working single-handed and the garden staff is inadequate. This refers to 1929, and in the present *Journal* the Gardens have to report a ten per cent reduction of the Government grant which they share in common with other State-aided institutions. On the whole, the moment scarcely seems propitious for the consideration of Sir Arthur Hill's suggestion that South Africa should try to maintain three botanic gardens, with the development of a sub-tropical botanic garden at Durban and a botanic garden with arboretum at Pretoria. It is good to see that the body of supporters for the Kirstenbosch gardens, provided by the Botanical Society of South Africa, continues steadily to grow in numbers. In this same report Sir Arthur Hill presses for the policy of making Table Mountain into a Nature reserve, and it is good to learn that action has now been taken by the Administrator of the Cape Province which gives complete legal protection to the flora and fauna of the Mountain.

#### Biology and Quantum Theory

PROF NIELS BOHR, of Copenhagen, has brought together a collection of articles dealing in a rather general way with modern physics, under the title "Atomtheorie und Naturbeschreibung" (Berlin Julius Springer, 1931. 5 60 gold marks). Reference is made in several of the articles to the question of the relation between the development of quantum theory and the formulation of the fundamental problems of biology. The point of view which is taken is that a consideration of the new ideas and methods of physics, often essentially foreign to ordinary conceptions and experience, may indicate how the discussion of the place of living organisms in our scheme of things should be approached. Prof Bohr directs attention to the existence of a natural limit to the investigation of life in the inevitable death of an organism which is subjected to a complete physical investigation of its atomic constitution. A recognition of the importance of such matters is perhaps becoming rather general, as we find Dr P. A. M. Dirac grouping the problem of life with the relativistic formulation of quantum mechanics and the nature of atomic nuclei—as a "more difficult" problem—in the introduction to a paper on quantised singularities in the electromagnetic field, in the *Proceedings of the Royal Society* for last September, but it can scarcely be irrelevant to refer here also to Samuel Butler's ingenious treatment of a similar topic in "The Book of the Machines", sixty years ago, in "Erewhon".

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#### Announcements

By an order of the Committee of Privy Council, Mr W. S. Morrison, M.P., has been appointed a member of the Medical Research Council, on the retirement of Major A. G. Church.

PROF G. ELLIOT SMITH, professor of anatomy in University College, London, has been given the honorary degree of M.D. by the Egyptian University, Cairo, on the occasion of its first convocation, held on Feb 27. Prof Elliot Smith was at one time professor of anatomy in the Government Medical School, Cairo.

THE third Pedler lecture before the Chemical Society, entitled "The Life and Work of Otto Wallach", will be delivered by Prof L. Ruzicka, of Zurich, on March 10, at 5.30 P.M. The lecture will be given in the Meeting Hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, London, S.W.1. Tickets of admission will not be required.

At the annual general meeting of the Association of Economic Biologists held on Feb 26, the following officers were elected: *President*, Dr W. B. Brierley, *Vice-Presidents*, Dr W. R. Thompson and Mr A. D. Cotton, *Hon. Treasurer*, Dr J. Henderson Smith, *Hon. Editors*, Dr W. B. Brierley and Mr D. Ward Cutler, *Hon. Secretaries*, Prof J. W. Munro and Prof W. Brown.

WE have already referred to the sixteenth Annual of the Paris Academy of Sciences (Feb 6, p 199), which contains a complete list of members, going back to 1795. The Academy has now issued a small volume containing a list of members and *correspondants* during the period 1666–1793 (Paris: Au Palais de l'Institut, 23, quai de Conti, 1931). This list was compiled by M. A. Lacroix, and gives the dates of birth and death, biographical notes, and posts held by the members.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned—An assistant biochemist at the General Hospital, Birmingham—The House Governor, General Hospital, Birmingham (March 12). An aircraft and engine inspector under the Government of India—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (March 12). A principal of the Sheffield City Training College for Teachers—The Director of Education, Education Office, Sheffield (March 14). An assistant medical secretary of the British Medical Association—The Medical Secretary, British Medical Association, Tavistock Square, W.C.1 (March 14). A professor of education and head of the men's training department of the University College of South Wales and Monmouthshire—The Registrar, University College of South Wales, Cardiff (March 22). A professor of geology in the University of Birmingham—The Secretary, University, Birmingham (April 11). A woman lecturer in biology at Edge Hill Training College, Liverpool—The Principal, Edge Hill Training College, Liverpool (April 19). An assistant bacteriologist in the Central Tuberculosis Laboratory of the King Edward VII Welsh National Memorial Association—The Bacteriologist, Institute of Preventive Medicine, The Parade, Cardiff.

### Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

#### Metastable Atoms in Mercury Fluorescence

MERCURY vapour of low pressure stimulated by the resonance line  $\lambda 2537$  emits fluorescent light for a time of the order of  $10^{-3}$  sec. This allows the fluorescence, when generated in a moving current of vapour, to travel away from its place of origin. The fluorescent light shows a spectrum of continuous bands. No complete or satisfactory account of this phenomenon has yet been given, and I do not think that the facts so far available are enough to make it possible.

It has been suggested by Franck and others that metastable mercury atoms or molecules are involved. I do not here enter upon any speculative considerations, but wish to give a short preliminary account of some experiments which prove that both kinds of metastable mercury atoms are in fact present in the stream of fluorescent vapour, when it is excited in the first instance by the resonance line.

Metastable atoms are not readily brought into evidence directly, but they can be tested for by

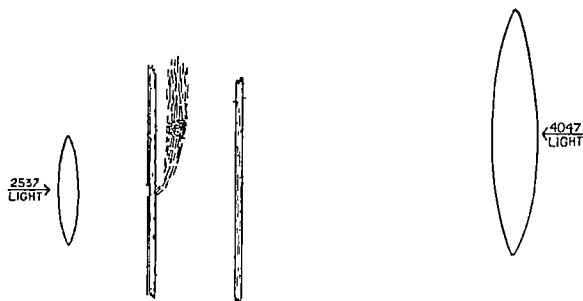


Fig 1

applying further excitation and observing the result. The lower kind of metastable atom,  $2^3P_0$ , requires the higher frequency (violet) to bring it to  $2^3S_1$ , the higher kind,  $2^3P_2$ , is raised to the same level by green radiation. The achievement of the level  $2^3S_1$  is brought into evidence by the complete visual triplet being emitted, and we can look for whichever component of the triplet is most convenient.

Fig 1 will help to explain the method of applying the test. The exciting resonance radiation comes in from the left through a small aperture in a metal diaphragm. The green fluorescence is seen to spring from the place where it enters the vapour, streaming up with the vapour as indicated. This fluorescence by no means distributes itself over the whole cross section (2 cm square) but remains isolated, with comparatively slight lateral spreading. At a distance of, say, 1 cm up, it meets with the converging beam of violet light,  $\lambda 4046$ , coming from the right, and where the violet beam traverses it, a marked increase of luminosity is observed. This consists mainly of the green line  $\lambda 5461$ , and indicates the presence of  $2^3P_0$  atoms, which are raised to  $2^3S_1$  by absorption of the violet line, and then (no doubt) emit the complete visual triplet. The green component is the best to observe, because there is no false light of this wave-length present. Moreover, it has the

advantage of being favourable for visual observation. The beam of violet light can be swept up and down, and the local development of the green mercury line can be watched, following closely the contour of the initial green fluorescence which has a continuous spectrum.

A similar experiment proves the presence of  $2^3P_2$  atoms, but in much smaller numbers. In this case the auxiliary illumination from the right consists of the green line  $\lambda 5461$ , which is absorbed by  $2^3P_2$  atoms and raises them to the  $2^3S_1$  level. The visual triplet is generated as before. The glare of green light already present makes it impracticable to observe the secondary development of this line, and the observation was made photographically by means of the blue and violet lines.

The same method is applicable to determine the distribution of  $2^3P_1$  atoms, but is not nearly so convenient for this purpose as the direct photography of resonance radiation. I do not enter into this matter here, beyond remarking that the  $2^3P_1$  atoms do not follow the distribution of the green fluorescence, their distribution being altogether different.

RAYLEIGH.

Terling Place, Chelmsford,  
Feb 11

#### Light as a Factor in Sexual Periodicity

IN the discussion which followed the papers by Dr J R Baker and Mr R M Ranson and Prof T H Bissonette, read before the Royal Society on Feb 4, I suggested that their conclusions concerning light as a factor in sexual periodicity involved a principle of wide application. Dr Baker had referred in his paper to the practical application of this principle by the poultry industry, and I remarked that Mr Hammond had pointed out to me that it was possible to construct graphs for the principal countries of the world showing a well-marked correlation throughout the year between egg production and the incidence of daylight. I stated further that the effects of artificial illumination were known also to breeders of canaries and other cage-birds, and that within my own experience the collared turtle-dove which has been kept under conditions of domestication for many generations will breed freely under ordinary room conditions in mid-winter under the added stimulus of artificial light in the evenings. I might have added that in tropical countries where environmental conditions are similar throughout the year, such as the Cameroons, the native birds have no restricted breeding season but breed at any time. Moreover, in the case of the Brent goose and various other species of geese, although pinioned birds may be kept for years in a state of perfect health in semi-captivity, they never or very rarely breed, and I suggested that such birds require the stimulus of prolonged daylight, which they obtain in their normal breeding habitat within the arctic circle, in order to excite the activity of the reproductive organs.

In the discussion, criticism was afterwards made as to the general application of the principle, and it was remarked that nocturnal animals, such as the bat, and animals that live underground, such as the mole, breed at certain seasons without the stimulus of daylight. Owing to lack of time, the discussion closed and it was not possible to reply to this criticism, otherwise I might have pointed out that the bat in its reproductive processes is a peculiar animal, at least in the case of the common pipistrelle and some other British species, since normally they copulate in the autumn and do not ovulate until the spring. It

(Continued on p 361)

# Supplement to NATURE

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## Reviews

### A Programme for Human Genetics

*Genetic Principles in Medicine and Social Science*

By Prof Lancelot Hogben Pp 230 (London  
Williams and Norgate, Ltd, 1931) 15s net

WHEN the history of genetics comes to be written, the beginnings of human genetics will not form its most creditable chapter. Theory outran practice in its development. The biometricians used the coefficient of correlation as a universal tool, the Mendelians attempted to force the data into the even more Procrustean frame of 1:1 and 3:1 ratios, the eugenists proposed the solution of very complex social problems on the basis of quite inadequate data. Meanwhile, opponents of the genetical point of view asserted that innate factors are of no serious importance in determining human conduct. Human genetics to-day are still in this highly uncritical stage of development, but Prof Hogben's book is at least the herald of a more scientific epoch.

The book is mainly occupied with criticism of former work in the same field. The first chapter deals with the relative importance of nature and nurture as revealed by the study of monozygotic twins and of adopted children. Its results will disappoint fanatical believers in the omnipotence either of heredity or environment. But at least they show that the problem can be solved, and that any solution must be quantitative. For any given character showing variation in a given population, it should ultimately be possible, by Fisher's method for the analysis of variance, to estimate the fractions of the total variance due to differences of environment, differences of ancestry, and segregation, respectively. The results will differ widely, not only for different characters, but also for the same character in different communities. Thus, at present adult illiteracy is mainly determined by nature in England, nurture in India. But a vast amount of further work is required before quantitative results are possible.

Geneticists will find the next three chapters most interesting. Prof Hogben gives a critical analysis of

the evidence that some human characters, such as albinism and colour-blindness, are inherited according to Mendel's laws. While the figures for colour-blindness agree perfectly with theory, those for albinism deviate by 4.7 times the standard error. This is not, of course, surprising, seeing that several distinct combinations of genes will yield a pink-eyed white rabbit, but it shows the danger of assuming determination by a single gene without critical and quantitative testing of the data. Unfortunately, it is doubtful whether Prof Hogben's method of analysis is the best possible. It is, at least, a vast improvement on none at all. The inheritance of the blood group genes and Bernstein's beautiful and powerful method for investigating linkage are next described. Then follows a discussion of the genetical basis of mental defect. It emerges that while, for example, amaurotic family idiocy is a simple and recessive character, Mongolian idiocy is mainly determined by an unknown environmental factor, and feeble-mindedness, an extremely ill-defined condition, depends both on nature and nurture, even if the former is the more important. Among the most interesting characters considered is the possession of blue sclerotics, generally with fragile bones. It appears that this condition can be caused either by a dominant gene or by prenatal environment in a mother carrying this gene. Frost found that seed colour in *Matthiola* is determined in exactly the same way.

A chapter on race, which demonstrates the lack of evidence concerning innate psychological differences between races, is followed by a discussion of selection. As this is largely a résumé of my own work, I should like to emphasise that it was Punnett in 1917 who first calculated the extremely slow rate at which rare recessive characters would disappear from a population were their bearers prevented from breeding. It is pointed out that the effect of eugenic measures would depend on the mode of inheritance of the characters encouraged or discouraged, and that cousin marriage may be a fruitful source of human abnormalities. Thus, in a group of mental defectives here cited, only

5 per cent had defective parents, whilst in a group of insane, 8 per cent were the offspring of marriages between first cousins. If these figures are representative, a revival of the prohibition of cousin marriage might be a more eugenic measure than the sterilisation of the feeble-minded.

In the last two chapters, Prof. Hogben gives his views on the social application of eugenic principles. He is careful to point out that such views are inevitably biased by the writer's political and other opinions. He succeeds, however, in demonstrating that there is no necessary connexion between the study of eugenics and the ultra-conservative opinions so often associated with it.

The book does not attempt to cover the whole field either of human genetics or of eugenic proposals. It contains one or two very dubious statements, for example "The genetic constitution of an individual depends on the identity of the parents. It does not depend on whether he or she happens to be the first or fifth child of a family." This neglects the fact that both linkage and selective elimination may vary with age. Nevertheless, no serious student either of genetics or eugenics can possibly afford not to read the book. If it provokes an answer on the same scientific level from a holder of what may be called the orthodox eugenic view, it will have done an immense service to the eugenic movement. Until such an answer is forthcoming, the present unfortunate breach between genetic research and eugenic propaganda is likely to be widened. An adequate answer to certain of Prof. Hogben's criticisms would serve to heal this breach. It is doubtful if anything less will do so.

J. B. S. HALDANE

### Psychology with an Anthropological Background

*The Psychology of a Primitive People: a Study of the Australian Aborigine.* By Prof. Stanley D. Porteus. Pp. xvi+438+48 plates. (London: Edward Arnold and Co., 1931.) 30s. net.

IN these days of specialisation, when a specialist has been defined as a person who knows something about his own subject and nothing about any other, a book such as this, which successfully combines two methods of approach to the problem in hand, is of exceptional interest and importance. Its author, primarily a psychologist, is also an experienced field anthropologist, who knows how to make friends with primitive folk, and how to take full advantage of opportunities for personal contact with them in their natural surroundings. Con-

sequently, he realises the importance of certain aspects of the problem he has set himself which are too often overlooked by writers on racial intelligence. As one out of many instances may be cited, the emphasis here laid on recognition of the fact that intelligence is manifested not only by capacity to meet new situations (which is, on the whole, the quality brought out by mental tests) but also by the ability "to deal with the age-long problems of the race, the struggle for survival and the reconciliation of man's individual and social needs."

The first portion of the book is accordingly devoted to a description of the country and the natives "under the guise of a narrative of the expeditions", so vividly written that it must surely put before the unaccustomed reader a picture scarcely less clear than the memories it will call up to those who are familiar with country of the kind described. "As far as we could see there was no living thing visible, it was as though Life had taken one look at the place and gone away. Yet somewhere out on those wastes are groups of natives maintaining a precarious existence, ceaselessly hunting for food day after day from dawn to dark." Against this background the author makes his natives live and move before us, and then—but not until then—he proceeds to analyse their behaviour, and to show how "at every point this behaviour is attuned to the hard conditions of their lives." He acknowledges, as must everyone who writes on Australian aborigines, his debt to Spencer and Gillen, but his account is full of first-hand experiences, since he gained the confidence of the natives so far as to be admitted to their ceremonies and shown their most secret treasures.

Social anthropologists will be interested in the chapters giving an analysis of native customs and institutions from the point of view of a psychologist. In discussing the characteristic features of Australian native society, such as their initiation rites, their marriage regulations, and the position accorded to their old men, the author develops his view that these and other observances have as their purpose "to knit the bonds of social cohesion closer, and to provide a counterbalance against socially disintegrating tendencies."

The third section of the book deals with mental tests and physical measurements, to which are added some interesting comparative data. The author does not assume too much knowledge on the part of his readers, but gives full descriptions of both tests and measurements, in terms intelligible to the non-specialist. In view of the unfortunate absence of uniformity which prevails

among physical anthropologists, he might well have gone a step further and stated exactly what technique was used, particularly in the case of sitting height and head length. He gives a detailed statement of the present position in regard to the vexed question of the relation between head size and intelligence, a subject to which he has devoted much attention in earlier studies of mental defectives and others.

In regard to the mental tests, Prof. Porteus is very clearly aware of the exceptional difficulties encountered when these are applied to people of primitive culture, and is correspondingly cautious in his interpretation of the results obtained. Of special interest is the attempt to devise tests in harmony with the cultural background of the natives, with the view of examining "the capacities fundamental to some aboriginal aptitude or skill." Thus their well-known ability as trackers suggested a test consisting in matching a series of photographic reproductions of footprints. The disadvantage of such specially designed tests lies in the difficulty of adequate standardisation, to ensure that the results of tests devised to suit different cultural conditions may be usefully interpreted and reasonably comparable. But apart from this, there would appear to be a definite place for such tests, if they really differentiate between degrees of capacity within a group. Many teachers of American Indian children in government schools have told me how thankful they would be for a test which would help in grading new-comers from the reservations, since much time and labour is wasted before the most suitable treatment for these children is discovered in the course of the ordinary school routine.

Special mention must be made of the photographs, which are noteworthy both for their intrinsic interest and for their technical excellence.

Some minor criticisms of format suggest themselves. The concluding summary might with advantage be given due prominence, instead of being tucked away in a single paragraph at the bottom of a page which has a sectional heading. The references, given as footnotes, would be more useful if listed together at the end of the volume.

This book should be included in the kit of everyone who sallies forth to study primitive people, no matter what his transport difficulties may be. That is the highest praise a field worker can bestow. The stay-at-home student will find it equally stimulating, and, indeed, it will appeal to anyone, whether student or not, who enjoys an account of real adventure.

BEATRICE BLACKWOOD.

### Scottish Prehistory

*Skara Brae a Pictish Village in Orkney* By Prof. V. Gordon Childe. With Chapters by Prof. T. H. Bryce and Prof. D. M. S. Watson. Pp. xiii + 208 + 63 plates. (London: Kegan Paul and Co., Ltd., 1931.) 31s. 6d. net.

NORTH Scottish prehistory has not perhaps always received much attention at the hands of non-Scottish prehistorians. This has been largely due to the geographical position of the country, which has been assumed to have been rather at the end of the world, at least until the arrival of the Scandinavian sea-rovers in historical times. It is probable, however, that the north of Scotland was by no means thus always 'the back of beyond', and in this area, as well as in the nearby islands, there lived folk whose culture, though simple, was both interesting to the student and not entirely autochthonous in growth. The present book deals with a series of explorations and excavations made under the supervision of Prof. V. G. Childe in the prehistoric village of Skara Brae, in Orkney, which was in process of being conserved by H.M. Office of Works at the time.

The importance of Skara Brae lies in the fact that the village was engulfed by a sand dune, and thus everything up to a height of some eight or nine feet has been preserved. Further, since wood always seems to have been rare in those parts, the villagers had to use stone where wood, if available, would doubtless have served throughout, and thus much that normally would have perished has been preserved. Culturally speaking, the whole can only be described as Neolithic, but actually in time the period of occupation was far less remote in all probability, and was contemporary with Bronze Age cultures, or even perhaps with the Iron Age elsewhere. The folk themselves were breeders of sheep and cattle. But everything cannot be dated to one age. Indeed, no less than four periods can be determined. Around and sometimes over certain of the buildings there has accumulated midden material which is itself also divisible into layers of different ages, and it has been found possible in some cases to assign these various midden deposits to one or other of the four periods just mentioned. Further, the earliest midden actually antedates the construction of the huts themselves, though a hearth typical of later times occurs in it. Culturally speaking, there is little change throughout the whole duration of the occupation.

Causes of several abandonments of the village may well have been the steady encroachment of the sand, with which the occupants seem to have been unable to cope. The final abandonment at the end of the fourth period may have been due to violent gales which produced rapid sand incursions. Afterwards, except for spasmodic returns and casual visitors, one of whom was a viking whose tomb has been found in the upper layers, Skara Brae remained unoccupied until the time of its recent excavation.

It is difficult to give an actual date for the habitation of the village, owing to the isolated life lived by these primitive island folk. Metal has not been found, but pottery techniques recall those of the later Bronze Age. Then, again, knobbed balls occur, and these have been considered by many archaeologists to belong to the Iron Age. Prof. Childe himself has shown that their general distribution is similar to that of the Scottish Pictish symbols. Again, brochs occur in Orkney, yet Skara Brae seems to have been uninfluenced by their intrusive culture. Are we to consider that this village is post-broch, in spite of many of the objects found? Or can we consider that it is of older origin, influenced by, if not truly belonging to, the Scottish Bronze Age, but untouched by the broch-building invaders who dominated the country for a time, only to disappear later, leaving the Skara Brae folk to continue as their forefathers had always lived?

These are but a few of the many things described and problems discussed in this fascinating book by Prof. Childe. While Skara Brae cannot be said to have played a vital part in the building of European civilisation, it does present an exceedingly interesting problem of study for the prehistorian. At the end of the book there are two chapters by Prof. T. H. Bryce and Prof. D. M. S. Watson, on the skeletal finds and the animal remains respectively. In the case of the former, the result of an exhaustive examination seems to show that the population of Skara Brae belonged to the same sort of mixed types as might inhabit the place to-day. The animal bones present no special difficulties. They include the sort of food fauna we should expect to find in a village of domestic animal breeders.

Prof. Childe is to be congratulated both on his work in the field and on his book. It may further be added that the illustrations, which include a coloured plan, are exceptionally fine and numerous.

M. C. BURKITT

### A Classic of Farming

*Thomas Tusser 1557 Floruit his Good Points of Husbandry* Collated and edited by Dorothy Hartley. Pp. 195 (London: Country Life, Ltd., 1931) 21s. net.

TUSSEER'S book was written in the middle of the sixteenth century and ran through many editions, mostly in the nature of enlargements. The first, 1557, consists of a "hundreth good pointes of husbandrie." To this in 1571 were added a "Beleef" (creed), "a hundrethe good pointes of Huswifry, and divers proper lessens for housholders." In the 1573 edition, the hundred good "pointes of husbandrie and huswifry" had each become five hundred, and lessons on gardening, "hopps and other needeful matters", with an abstract before every month, were subjoined. Here first appeared the autobiography of Tusser—in verse. The last edition issued in the author's lifetime was that of 1580, but from time to time reprints have appeared.

The autobiography is full of grim humour. The woes of a chorister are set forth, followed by those of a reluctant scholar at Eton—"fifty-three stripes at once I had, for fault but small or none at all." Thence Tusser went to Trinity College, Cambridge, and afterwards to Court. After this he engaged in farming in various places, Cattewade in Essex, Suffolk, Norwich, and elsewhere. He lived for a time in London, whence he fled during the plague, and returned to Cambridge.

Although his book abounds in good advice, and its worth is attested by its popularity, poor Tusser died in a debtor's ward, bequeathing the money owed to him as his only wealth.

The book, as enlarged in the later editions, is a sort of 'enquire within upon everything' concerning a farmer's life. In addition to the purely farming matters, Tusser writes of herbs, family doctoring, the upbringing of children, the use of tools, and of many country themes.

The editor's foreword says truly: "If there be earth magic through a quill, it is here, for between the uncouth lines we hear the year pass." This for the general reader, for the country man there is much beside—the sixteenth century life and management of a small farm, the old recipes, the economies no longer practised. The rotation of crops was already known, and Tusser advises fallow-barley-peas-wheat-fallow. Grain should always be followed by a pea crop, which, failing a good sale, would fatten swine. Rye was a regular crop and ingredient of bread, and brank (buck-



wheat) was grown both for feeding stock and as manure for the land

Even the 'weeds' had their uses. Mare's-tail was gathered for polishing purposes and used by fletchers and combe-makers. Whin was put up for fencing against sheep, and broom-water used as a remedy for scab. Mast was gathered and stored for the swine. Wormwood was laid on the floors of houses as a preventive of fleas.

On the veterinary side there are interesting notes. Thus we read that horses must be bled at Christmas time, and that a bullock off his feed can be cured by slicing his tail and rubbing in soot and garlic, even to-day this legendary cure is practised. Surely too we have a 'vitamin' treatment in the giving of verjuice, made from crab apples, to the cows, a pint at a time between Christmas and May.

We get a very clear picture of the communal life of a farm, where work was hard, but was broken by feasts and holidays, each with the appropriate good fare shared by master and man, mistress and maid.

Forget not the feasts that belong to the plough

For comfort with labour should sometime be had. Such feasts are here set forth. On the other hand, we have Tusser's warnings against unprofitable servants.

Trust never to boyes, if thou trust well to spede  
Kepe never such servants as doth thee no good  
No breakfast of custome provide for to save  
But only to such as deserveth to have  
Children were better unborne than untaught  
Good servants hope justly some friendship to fele

Miss Hartley has added, in the form of footnotes, recipes and notes from contemporary sources, and the book is set with illustrations, English and Flemish, of approximately Tusser's date. A book to be savoured slowly, not taken at a gulp, but truly good fare. E G

" . . . and brought forth fruit . . . an hundredfold "

*Ministry of Agriculture and Fisheries Bulletin*  
*No 28 Artificial Fertilizers in Modern Agriculture*  
By Sir E J Russell Pp viii + 202  
(London H M Stationery Office, 1931) 3s net

ARTIFICIAL fertilisers and the breeding of new varieties of plants constitute the two really spectacular achievements of scientific agriculture, for by augmenting production they have

contributed materially to human welfare. "Too materially," says the sceptic, "we have far more wheat, barley, sugar, etc., than we can consume." Such a view, however, ignores the fact that about two-thirds of mankind, residing in the Far East and Russia, 'enjoy' a very low standard of living compared with that of most western peoples, and that China alone is said to lose several millions of population every year from starvation, direct or indirect. From the world point of view, Malthus has been right: population has tended to outstrip food supplies, but whether this tendency will persist depends upon many factors—for example, how the use of fertilisers, improved organisation of resources, transport, and distribution will affect supply, and how movements of population, the practice of birth-control, and pursuit of a high material standard of living will influence demand.

Although the consumption of fertilisers has made great strides recently, really high consumption is confined to a very few countries, and the scope for further increase is very great. Apart from financial stringency, the chief obstacle appears to be lack of knowledge, and no better book for combating this ignorance can be imagined than this recent contribution from the pen of Sir John Russell, assisted by his able staff at Rothamsted. The book—somewhat ungenerously termed a 'bulletin'—may not be a farmer's book, but it should be indispensable to agricultural teachers and advisers, as well as to the man who farms scientifically. It is a model of sound, impartial, and lucid workmanship, and the perusal of it leaves us asking for more.

The bulk of the book is devoted to descriptions of the chief nitrogenous, phosphatic, and potassic fertilisers, their effects on the growth and composition of crops, how these effects vary on different soils, and how they are influenced by the weather. History is not neglected, practical considerations like amounts, times, and rates of application of fertilisers are adequately treated, and there is a short chapter on the new concentrated complete fertilisers. Results obtained at Rothamsted occupy the centre of the stage, but there are also valuable references to work done in Germany and elsewhere. If the 'bulletin' had not been intended mainly for practical farmers in Great Britain, the author might have gone even farther afield and told us of the 'epic of superphosphate' in Australasia and South Africa, of the virtues of potash, 'super', and sodium nitrate in the great cotton-belt of America, and of the surpassing value of ammonium sulphate

for crops like sugar-cane, paddy rice, oranges, and tea in the tropics and sub-tropics, but perhaps he has these things in reserve for a future occasion

Not the least interesting feature of the book is the statistical and economic information supplied, for example, that relating to the average crop increases that are obtainable over a series of years from the use of ammonium sulphate. Basic figures of this kind are badly needed for many countries, for when supplemented by cost figures and by prices which farmers receive for their produce at the farm, they give us the essential data required to answer the question 'How much fertiliser does it pay me to put on?' The evidence given in this book certainly indicates that in normal times the use of fertilisers for nearly all crops is extremely profitable, at any rate in countries which lie within the ambit of the world's trade, but more light is required on possibilities in territories like parts of China, Siberia, and India, which, owing to deficient transport, depreciated exchange, or other causes, are cut off from the great world markets

It seems, however, impossible to set a limit to the appetite of the hungry earth for fertilisers, both natural and artificial. What would Lawes have thought had he lived to learn that the world was consuming some fifteen million tons of super-phosphate per annum only eighty-seven years after he had started its manufacture at Deptford? And how would Crookes have reacted to the news that thirty-two years after his famous utterance at Bristol the world was using more than eleven million tons a year of nitrogenous fertilisers, more than one-half of which was derived from atmospheric nitrogen? Much has indeed been done, but more remains to be done

### The Thames Estuary

*The Geography of London River* By Prof L. Rodwell Jones Pp x + 184 + 4 plates (London Methuen and Co., Ltd., 1931) 21s net

THERE are rivers mightier and nobler than the Thames broad and stately floods, masses of moving waters, which impress the onlooker with a sense of immense and overwhelming power. Even within the narrow limits of the British Isles, the Thames has no priority of length and size. But there are few waterways anywhere in the world which rival it in historical interest and significance, or in the wide range of its commercial activities. The Thames is as much a part of the fabric of English history as is the great city

on its banks, for which it is the main avenue of communication with the outer world and the chief means of transport for its trade. It is impossible to imagine London without the Thames, or to picture what the English capital would have become if it had continued to be identified with Winchester or York. To the Londoner, the Thames is a source of local patriotic pride. It is his heritage, his especial possession. "Are not Abana and Pharpar, rivers of Damascus, better than all the waters of Israel?" So Prof Rodwell Jones, with every justification, adopts the unofficial designation of the mariner and calls it the "London River."

Undoubtedly, there is scope for such a work as this. The City and Port of London have both been the subject of exhaustive and authoritative treatises. The River rightly claims a share of notice. To be really representative, the notice should embrace the stream from its remote source in the Cotswolds to its mouth. Prof Rodwell Jones, however, does not attempt a task of such magnitude. He is content to undertake a portion of it. His book is "about the Thames Estuary, its physical conditions and economical activities", and he deals more particularly with these matters within the limits of the nineteenth century and the first thirty years of the twentieth, contrasting the port in its physical and commercial aspects as it was a hundred and thirty years ago and as it is to-day.

By way of introduction, there is a description of the general physical setting, with a concise geological survey showing that the Thames is characterised by a duality of basins—a 'catchment basin' at its source among rocks of Jurassic age, and a 'structural basin' which is entered through Goring Gap and is constituted by the synclinalum between the Chilterns and the North Downs, containing Tertiary and Quaternary deposits. After that comes a short description of the primitive site and a discussion of the early settlements along the banks, with a consideration of the circumstances which favoured their origin and growth, grouped under such types as the bridge-port, the estuarine bluff, and the ford.

This is followed by an account of the river, as developed by natural causes and artificial measures and exploited for navigation and commerce at the beginning of the last century, this period being taken as a convenient starting-point for the main theme of the book. The physical features of the date are based on Bullock's chart of 1830, compared with one or two earlier but less reliable

and sectional publications Prof Rodwell Jones summarises the position as follows

"At the opening of the century there were no considerable docks, save only that of Mr Perry at Blackwall, and the Howland Wet Dock on the Surrey side of Limehouse Reach. On the North shore, continuous settlement had proceeded eastwards only as far as Shadwell, except that along a road used by traffic for the East India Company's store at Blackwall. On the south side, continuous settlement reached only as far as Rotherhithe. The pools were lined with wharves on both sides and various stairs led down to the shipping and to ferry-ways. There was very considerable shipping at Blackwall, Deptford, Woolwich, Erith, and Northfleet. The marshlands and marsh shores were almost free of buildings. The western embanked shore of the Isle of Dogs was the site of numerous windmills."

As regards trade, circumstances tended to concentrate shipping in or near the Pools, which were becoming congested. The Report of the Commission of 1796 furnishes statistics which show that the total tonnage of vessels engaged in the foreign trade, which entered and left the port at that date, was just over a million (1,051,508), while the coast-wise tonnage was fully a million and a half (1,662,700). The latest figures of tonnage in the book are those of 1929, but since those of 1930 are higher, we may not unjustifiably contrast the two million and a half tons of 1795 with the fifty-eight millions of 1930. It is only right to add that the returns for 1931 are showing a falling-off, due, to some extent, to the prevailing economic depression. Here it may be remarked that a comparison of Prof Rodwell Jones's figures for 1929 with the figures for the same year as recorded in the Annual Report of the Port of London Authority, suggest that, in the former, either coast-wise tonnage is not included or that some other exclusion is made. The tonnage figures for 1929 in Table I (page 132) aggregate only 40.55 millions.

So considerable a mass of material in the book cannot be discussed in detail, but it is desirable to mention two matters of outstanding interest—the tides and the river walls, or embankments. The two are interdependent, since the walls were constructed on account of the tides. As is well known, both sides of the river from London to the sea are bordered by earthwork embankments of appreciable height, which serve to protect the low-lying marshlands (covering an area of more than forty square miles) from inundation. These river walls, as they are termed, aggregating a hundred miles or more in length, contain an enormous mass of material, both clay and stone, the deposit and

facing of which must have occasioned a tremendous outlay in the first instance. The origin of the work is lost in obscurity—the walls, or the main parts of them, date back, at least, to the twelfth century, but whether they were constructed by the Normans or by the Saxons or even, more remotely, by the Romans is open to conjecture. Whatever the date and nature of their origin, they play an essential part in confining and defining the bed of the river, and in providing an extensive area of reclaimed land for agriculture and building purposes below the high-water level of many tides.

The tides of the river Thames, though not of the same order as those of the Bristol Channel or even of the Mersey, are, nevertheless, considerable. In general terms, the range of spring tides is about twenty feet, but between the level of the lowest recorded low-water and that of the highest high-water there is a difference of so much as forty-one feet. Exceptional tides have taxed the resistance of the river walls to the utmost, as was recently exemplified in the disastrous experience of Jan 7–8, 1928, when, under the influence of a surge, or disturbance, in the North Sea, due to meteorological causes, immediately following a period of heavy rainfall on a frozen surface in the Thames Valley, which produced an abnormal discharge of upland waters, the spring tide rose to exceptional heights in the estuary, topping the river walls in places and causing numerous breaches of greater or less extent, and, unfortunately, causing loss of life in the Westminster and Hammersmith districts.

The able discussion of these and other matters in Prof Rodwell Jones's book makes it one of considerable interest to the geographer, the meteorologist, the historian, the engineer, the economist, and, in fact, all those whose studies are in any way connected with the estuary of the Thames. The book is well printed in bold type and the diagrams are clearly drawn. One or two slips of the pen should be noted. Dart on p 9 should be Darent (the mistake is repeated in the index), Mr (now Sir F) Palmer's Christian name is Frederick, not Frank (p 98). On p 169, the "Daily Telegraph Mills" should be the "Dartford Paper Mills", the connexion with the London journal having ceased. Also, there is another important paper mill at Dartford and one at Greenhithe not shown on the diagram, Fig 43, on p 168. The depth of the sill at the entrance to the Royal Victoria Dock is now 20 ft 6 in, not 28 ft as given in Fig 37 (p 150). The entrance has been altered and converted into a barge entrance. BRYSSON CUNNINGHAM

### Geology of Malaya

*The Geology of Malaya* By J B Scrivenor Published with the Authority of the Federated Malay States Government Pp xx+217 (London Macmillan and Co, Ltd, 1931) 16s net

READERS of Mr Scrivenor's book on "The Geology of Malayan Ore-Deposits" will welcome this companion volume on the geology of the fascinating and enigmatic land which has claimed the author's attention since 1903. In the introduction, an interesting and instructive account is given of the history of geological investigations in Malaya, including a brief account of the Kinta tin-field controversy. It is justly pointed out that the Kinta valley does not provide a key to the geology of the country, and that while debate has been focused on that small and intricate area, the Survey Department has been occupied with the whole of Malaya. Progress has now reached the stage where linking up with the Netherlands Indies, Indo-China, and Lower Burma has become practicable. In all these lands closely accordant results have been achieved.

After a general statement of the leading geological and geographical features of the Peninsula, there are chapters dealing with the late Palaeozoic and Triassic sediments and the associated Pahang Volcanic Series. During this long period, the site of Malaya was a sea of moderate depth which was finally silted up by sediment from the east. Great crustal movements occurred later and led to great intrusions of granite, which are responsible for the valuable tin deposits of the country.

An important chapter is devoted to the granite and the associated igneous rocks. A post-Triassic age now appears to be well established, and although there are no Cretaceous sediments in Malaya, the evidence from adjoining countries suggests that the intrusions may be of late Cretaceous age. The post-granitic rocks include Tertiary coal measures, high-level alluvium which appears to be Pleistocene or older, and recent alluvium and pumiceous ash.

The remaining chapters deal successively with weathering and laterite, metamorphism, with special reference to a puzzling series of tourmaline-corundum rocks, thought provisionally to be altered bauxite, various minerals and tektites, and materials of economic interest other than ores. The book concludes with a bibliography complete to 1930 and a good index. A noteworthy feature is a colour-printed geological map of Malaya, on the scale of 12 miles to the inch, which is folded in a pocket at the end of the volume.

The book is written throughout in a clear and pleasant style, enlivened with flashes of humour and local colour. Mr Scrivenor is to be warmly congratulated on having made available in so acceptable a form the conclusions he has reached after more than a quarter of a century's arduous work in a tantalising land that has become notorious for the difficulty of its geological problems.

### Physics in the Making

*Recent Advances in Physics (Non-Atomic)* By Prof F H Newman Pp ix+378 (London: J and A Churchill, 1932) 15s

FRANKLY, we find the title of Prof Newman's new book a little puzzling. He sets out to deal with recent advances in non-atomic physics, and, knowing his flair for exposition, we looked forward to a readable account, with due emphasis given to the experimental side, of recent developments in what we might call macroscopic or molar physics. His account is readable enough, and interesting experimental detail bulks largely therein, but the choice of topics bears singularly small relation to the title. Wave mechanics, statistical mechanics, electromagnetic radiation, including a discussion of infra-red spectra,  $\gamma$ -rays, cosmic rays, and the scattering and diffraction of X-rays, ninety pages on modern magnetics, and, under the heading electricity, a discussion, *inter alia*, of electrolytic conduction and of super-conductivity. These be strange themes to meet in a work where we had hoped a comfortable certainty would reign supreme and electron waves would cease to surge and roar.

The balance is to some extent redressed by a chapter on sound, which includes discussions on architectural acoustics, on sound-ranging, filters, and ultra-sounds, another chapter dealing with low temperatures and their measurement, and sections treating of high pressure researches and of atmospheric electricity. Nay, with a little twisting of the terms of reference, we may even include such topics as liquid viscosity and surface tensions, certain aspects of which Prof Newman discusses in fairly full detail.

Truth to tell, it is impossible to make a division of topics which shall be strictly logical and shall avoid serious overlap. Prof Newman points out, perhaps a trifle optimistically, that "the whole trend of modern science is, as it should be, towards correlation." Nevertheless, we may make a very convenient, if rough division, into molar physics, atomic physics—where the concept of the billiard-ball atom still subserves a useful purpose—and

sub-atomic physics The difficulties and overlappings inherent in such a classification are obvious, but the section first-named will include topics which could very well replace some of the 'sub-atomic' sections of Prof Newman's book Photo-elasticity, recent developments in measurements of high precision, advances in applied physics, of which the Michell thrust block may be cited as an example, geophysical measurements, pyrometry—these are but a few of the topics which we should rejoice to see Prof Newman handling and elucidating with his wonted skill

We wish it to be clearly understood that we are suggesting substitution rather than addition The subjects which Prof Newman has discussed are so many and so diverse that some of them are necessarily treated in a cursory manner which, perhaps, makes the matter seem rather easier than it really is But we do not desire to seem ungrateful Prof Newman has collected a vast mass of information in the three hundred and seventy pages of his text, and the book should prove very useful to a hard-pressed generation of students which has neither the leisure nor the will, among the multiplication of subjects which crowd our syllabuses, to scan critically and to abstract for itself original papers of importance It should be added that for those who have time and inclination to refer to original sources, Prof Newman provides carefully selected bibliographies of the various topics discussed

ALLAN FERGUSON

### Biophysics in Muscular Action

*Adventures in Biophysics* By Prof A V Hill  
Pp ix + 162 (London Oxford University Press, 1931) 12s 6d net

THE attractive title of this book is fully justified by its contents Anyone who wished to sing with the Greek poet the praises of the inventive wit of man, σοφόν τι τὸ μηχανόεν τέχνας ὑπὲρ ἐλπίδ' ἔχων, could have no better example than some of the adventures in biophysics, of which Prof Hill here gives an account Technical skill and ingenuity in the use and construction of thermopiles made it possible to measure the rate at which a muscle liberates heat, when it is at complete rest, the basal metabolism of the living tissue This basal rate was measured with the muscle in air or oxygen, and in nitrogen free from oxygen It was about twice as great in oxygen as in nitrogen The life of a tissue may be regarded as consisting in the balancing of destructive catabolic changes by reconstructive anabolic changes heat may be sup-

posed to be liberated by both kinds of change In the absence of oxygen the anabolic changes would not appear

When the muscle becomes active as a result of stimulation, additional heat is of course produced, whether oxygen is present or not If oxygen is present, heat is produced for some time after the activity has ceased, and is a measure of the anabolic processes by which the muscle recovers from the changes attending activity, but finally the original basal rate is reached at the same level as before, the return is slow but complete In nitrogen the return is rapid but incomplete It is rapid because the slow anabolic processes involving oxidations are impossible without oxygen, the fact that it is incomplete seemed to mean that the effect of activity was to increase the instability of the living system and so lead to an increased rate of catabolic change A very interesting observation and a very plausible interpretation, only it was surprising that the rate of catabolic change should increase directly in proportion to the amount of activity

Among the tests to which the observation was put, was one in which hydrogen was used instead of nitrogen to displace the air surrounding the muscle The result was that the basal metabolic rate after activity seemed to have been increased more than it would have been in nitrogen, and the plausible, interesting explanation became impossible The phenomenon was then proved to be due to the lowering of the vapour pressure of the muscle by the activity In activity, a few large molecules break down into a larger number of smaller ones, the osmotic pressure rises and the vapour pressure falls Consequently, water from the solutions in the instrument, with which the vapour pressure of the muscle was previously in equilibrium, condenses on the muscle, and it is the heat released by this condensation that accounts for the apparent increase in metabolic rate of the resting muscle In hydrogen the effect is greater because of the more rapid diffusion of water vapour in the less dense gas

The thermopile has thus proved to be an incredibly sensitive means of recording minute differences of vapour pressure, 1 mm on the galvanometer scale corresponding to a change of vapour pressure of the order of 0.1  $\mu$  of mercury, or to an addition of less than 1 mgm of lactic acid to 100 gm of the solvent system of muscle It is possible to calculate from the known chemical changes in an active muscle that these are capable of accounting for not more than four-fifths of the observed change in vapour pressure, and Prof Hill argues from this as to the incompleteness of our knowledge of the

chemistry of muscle It is similarly possible to calculate whether all the water in muscle (or in egg white or blood or other such fluids) is free, in the sense that it is available for the exercise of osmotic pressure by substances dissolved in it, and the result obtained is that, within at any rate about five per cent, all of it is free

With this technique and the assistance of his colleagues, Prof Hill has collected many new data on the fascinating questions involved in the relation between the osmotic pressure of sea water and the body fluids of its inhabitants, or the descendants of its inhabitants, including man In man, he has found that the osmotic pressure of the blood, one of the primary physiological constants, but one which is two per cent lower in females than males, may be increased more than ten per cent by muscular exertion, and indeed probably as much as twenty per cent in an extreme case The experiments on marine animals performed at Plymouth have brought out a number of new facts of the greatest interest in extension of those described by Prof W J Dakin more than twenty years ago

The last two of the five lectures are devoted to some of the latest work on the time relations of the heat production in muscle, and the attempt to correlate these with the more recent data upon the chemistry of muscle, the influence of viscosity on muscle mechanics, etc Prof Hill's record of adventures in these subjects extends now over some twenty years, and the latest of them are as full of interest as any Blessed are they that seek, for they shall find what they were not looking for

### Progress in Physical Chemistry

- (1) *Photochemical Processes a General Discussion held by the Faraday Society, April 1931* Pp 353-573 (London The Faraday Society, 1931) 10s 6d net
- (2) *Recent Advances in Physical Chemistry* By Dr Samuel Glasstone Pp vii + 470 (London J and A Churchill, 1931) 15s

(1) **T**HE Faraday Society's general discussion on "Photochemical Processes", held at Liverpool on April 17-18, 1931, follows a similar discussion at Oxford after an interval of less than six years The interval has been marked by a rapid development of our knowledge of molecular spectra, so that it is now possible to foresee in a much more definite manner the mechanism by which the molecule is activated by the initial absorption of light In particular, it is possible by a study of absorption spectra to distinguish mere

electronic activation from a *primary dissociation*, in which the molecule is immediately shattered by the incident light, and from *predissociation*, in which the activated molecule lives long enough to execute a few vibrations and thus to give rise to a band spectrum, but not long enough to exhibit a quantised rotation, so that the absorption bands are devoid of fine structure

At the Liverpool meeting, of which a report has now been issued as a separate volume, this aspect of modern photochemistry was admirably set out by Prof Mecke, in an introductory address to the section of the discussion on molecular spectra in relation to photochemical change A similar introduction to the section on photochemical kinetics in gaseous systems was given by Prof Bodenstein This address was noteworthy for the evidence submitted that, whilst chain reactions are a frequent sequel to photochemical activation, it is extraordinarily difficult to identify the links in the chain In the photochemical combination of hydrogen and chlorine, where the largest number of data are available, no theory has yet been developed which explains all the known facts, and it may be suspected that in other cases the completeness of the explanation may be due to lack of data rather than to correctness of theory It is, however, now possible to identify certain molecular fragments, such as the hydroxyl radical, by means of their band spectra, and thus to establish their real existence as intermediate products of photochemical change, and Prof Bodenstein has himself proved the intervention of  $\text{ClO}_2$  by isolating this radical in a polymeric form as  $\text{Cl}_2\text{O}_6$

Prof Berthoud's introduction to the section on photochemical change in liquid and solid systems was concerned mainly with the mechanism of activation and deactivation, and with the problem of explaining the influence of wave-length and temperature on photochemical efficiency Finally, the introductory address to the last section of the discussion was given by Prof Baly, on photosynthesis, and described experiments made during the past three years to secure increased photochemical efficiency by the preparation of better catalysts, and in particular by freeing them from alkaline impurities

Papers on the photographic process were contributed by Prof Eggert, of Leipzig, who was present and took part in the discussion, and by Prof Weigert, of Berlin Prof Warburg, of Berlin, read a paper on the application of the law of photochemical equivalence to vital processes Dr. Franckenburger, of Ludwigshafen, also read



two papers, but Dr Herzberg, of Darmstadt, and Prof Rollefson, of Berkeley, were unable to present their papers in person. The organising committee (Profs Allmand, Baly, and Porter, Dr Griffiths and Dr Norrish), the members of which contributed six papers to the discussion, were fortunate in securing such widespread support, and have added another item to the record of successful efforts which stand to the credit of the Faraday Society as an organiser of discussions of international interest and scope.

(2) Dr Glasstone has had a straightforward and congenial task in giving an account of "Recent Advances in Physical Chemistry", since his book is addressed to senior students, who may be assumed to possess all the preliminary knowledge that is needed in order to appreciate the most recent developments of physical chemistry. On the other hand, he has not abused this advantage by wandering unnecessarily into the domain of pure physics or by using mathematical methods that are beyond the capacity of the majority of chemists.

Dr Glasstone's first chapter is a long one on the electronic theory of valency. This is developed on simple lines from a consideration of quantum numbers, without introducing a detailed theory of atomic spectra. The various types of valency are then discussed, the 'co-ordinate link' being represented by a single arrow, which the author finds it necessary to distinguish from the directional arrow of a chemical equation by printing the latter in heavier type. In this connexion, attention may be directed to the real advantages which follow from representing these mixed valencies by making use of the hypothesis of localised atomic charges, which was developed for this purpose by the reviewer in 1922, and has now been sanctioned from the point of view of wave mechanics by its systematic use in Pauling's recent paper. In the present chapter it would have eliminated a fictitious lack of symmetry from the formulæ assigned to the sulphite, sulphate, acid fluoride, borofluoride, and ammonium ions, when formulated as products of co-ordination, it would also have got rid of a similar lack of symmetry in the formulæ for the polymeric forms of the water molecule, and have prevented an obvious error in the translation into electronic nomenclature of Moore and Winnill's formula for the undissociated form of ammonium hydroxide.

The second chapter describes the applications of the parachor to valency problems, including the much-debated single electron bond, on lines that are already familiar from Sugden's own book on the "Parachor and Valency". The third and

fourth chapters are on dipole moments and molecular spectra. Useful summaries of recent work are given in each case, and these two chapters may be regarded as completing the section of the book in which the structure and properties of chemical compounds are discussed.

The central section of the book is concerned with chemical reactions, and also includes four chapters, since a chapter on homogeneous gas reactions is followed very logically by one on photochemical reactions, whilst the chapter on heterogeneous catalysis is rightly preceded by one on the properties of surfaces. The remaining three chapters are concerned with solutions, under the three headings of "Solubility", "Strong Electrolytes", and "Acid-Base Catalysis", leading up to the modern theory of acids and bases and their activity as catalysts.

It is not practicable in a brief review to refer in detail to these individual topics, but at each point at which the reviewer has sought to check up the information given, it has been found that recent advances have been correctly recorded and adequately discussed. The book can therefore be recommended without hesitation to those advanced students who may wish to supplement the information given in the more systematic books on physical chemistry by studying some of the 'live topics' which are now conspicuous in physical and chemical literature.

T M L

### Properties of Steam

*The Revised Callendar Steam Tables (1931)* Calculated by Dr Herbert Moss from the New Data and Formulæ of the late Prof H L Callendar. Published for the British Electrical and Allied Industries Research Association. Pp 56 (London: Edward Arnold and Co, 1931). With thumb index, 12s 6d, without thumb index, 10s 6d.

THE "Enlarged Callendar Steam Tables" published in 1924 gave the properties of steam up to 2000 lb per sq inch. It was known, however, that the quantities above 500 lb per sq inch would require revision when more exact experimental information became available. With the assistance of the British Electrical and Allied Industries Research Association, Prof Callendar was enabled to extend the researches by making direct measurements of the total heat of both water and steam at pressures up to 4000 lb per sq inch, and temperatures up to 750° F. The measurements covered the whole of the critical region and showed that the objection to the Joule-Thomson equation, first applied to steam by Callendar in 1900, had no

foundation in fact. A general account of the theory and equations was communicated to the Royal Society in 1928 and a set of skeleton tables, calculated from the modified equation, was included in the Report to the Research Association and reprinted in a paper presented to the Institution of Mechanical Engineers in 1929.

Dr Herbert Moss has increased the debt which engineers owe to the late Prof Callendar by his work, which has led to the present volume of tables. He has re-calculated the whole of the values at lower pressures and has extended the tables to 4000 lb per sq inch and 1000° F. The values of the saturation temperatures at the higher pressures and the corresponding values of the other properties of saturated steam differ slightly from those given in the skeleton tables of 1929. A re-determination of these saturation temperatures has been made by Mr G S Callendar and Mr A C Eger-ton, and their values appear in the present tables.

Three tables in all are given. Table I includes the properties of dry saturated steam and water at saturation temperature from 29.6 inches of mercury vacuum to 30 inches of mercury positive gauge pressure. Table II (pp 16-55) gives the properties of dry saturated and superheated steam from 1 lb to 4000 lb per sq inch. Table III shows the values of  $P^{3/13}$  for use in calculating adiabatic heat drops. Fahrenheit units are used throughout. The tables are preceded by a short account of the Callendar equations with the new constants, together with explanations of methods of interpolation. The size of page adopted, 11 inches by 8 inches, enables each table to be clearly presented and easily read. The printing is beyond reproach and the thumb index is a useful adjunct. No engineer engaged in steam engine and steam turbine design can afford to dispense with this volume.

### Stainless Steels

*Stainless Iron and Steel* By J H G Monypenny  
Second and revised edition. Pp ix + 575 + 55  
plates. (London: Chapman and Hall, Ltd.,  
1931.) 25s net.

**D**URING the five years which have elapsed since the publication of the first edition of this work, the metallurgy of the stainless steels has developed very rapidly. Much research, in which Great Britain has taken its full share, has been carried out upon their metallography and properties. As a result many new types of stainless steels with much higher contents of chromium, with or without nickel, copper, tungsten, etc., have

been developed. In order to deal with these newer materials, the present edition has been almost completely rewritten and more than doubled in size. It is a book of first-class merit, prepared by one who is perhaps the foremost authority in this particular field.

How complex this group of steels has become may be realised from the fact that no less than thirty-seven pages are required for the consideration of the principles underlying the choice of a particular steel for a specific purpose. Further, steels which started their public life less than twenty years ago merely as materials resistant to atmospheric corrosion or to chemical attack have developed, in addition, into alloys the mission of which is to resist oxidation and to retain their strength at high temperatures. Nearly sixty pages are, therefore, devoted to the discussion of the rate of oxidation and the mechanical properties of certain of these steels at temperatures up to 1000° C.

From the time at which the steel leaves the manufacturer's hands to that at which the finished article is ready to be put into service, it may pass through many processes of fabrication and much harm may be done. Much good material has been irretrievably ruined by the use of processes—of welding, for example—which have proved quite satisfactory when applied to ordinary carbon steels. The dangers which beset the fabricator, and the precautions to be adopted, are matters which demand full and specific consideration. In discussing such matters the author's wide practical experience enables him to be of very real assistance. Although certain difficulties are still incompletely overcome, the knowledge where trouble may occur is of itself a valuable asset. Even if it does no more than carry one to those to whom these steels have been made a subject of special study, much that is good will have resulted. These materials are of great complexity and their metallographic characteristics still very far from being completely elucidated, a fact which the very tentative nature of the author's attempts to deal with the effects of chromium upon the iron-carbon diagram emphasises.

That the book represents a most important addition to the metallurgical literature of the special steels no one can doubt. The first edition has been out of print for three years, but in the result the delay in presenting this second edition has been eminently justified.

There is one further incidental point which deserves mention. A very considerable amount of the new data contained in this volume has been

obtained by the author in the laboratories of the firm with which he is associated. Permission to publish this mass of information would, even a very few years ago, have been almost unthinkable. It argues well for the enlightened views of this firm that it is now possible to do this, and is a good augury for a much more rational attitude on the part of other industrial organisations to an interchange of knowledge which, in the end, will be to the good of all.

F C T

### Harmonic Analysis

*The Theory of Spherical and Ellipsoidal Harmonics*

By Prof E W Hobson Pp xi+500 (Cambridge At the University Press, 1931) 37s 6d net

THE need for a treatise on harmonic analysis, more particularly on spherical harmonics, has been recognised for a long time by mathematicians who teach the subject or who find it necessary to use spherical harmonics in their investigations. Those who had the good fortune to be introduced to the study of the subject by the author of the present work had always hoped that he would find time to undertake the preparation and publication of such a treatise. It may be said at once that the work now published fulfils the expectations they had formed. Although many books which contain information about spherical harmonics have appeared since the publication of Heine's "Kugelfunktionen", none of them has claims to be considered a complete treatise on the subject, and Heine's work, though it has proved of great service to students of the subject and to mathematicians who had occasion to use harmonic analysis in their investigations, is a compilation of results which contains the material for a treatise rather than a treatise. Much has been written on the subject since the appearance of Heine's two volumes. The mere perusal of the literature involves much labour, and the task of selecting from this mass of literature what is of prime importance to students of the subject and what is necessary for the mathematical physicist is one which demands a wide knowledge of the related branches of mathematics and of applied mathematics. That the author has fulfilled these requirements the present treatise is the evidence.

The first four chapters give a complete account of the origin of the ordinary spherical harmonics, Legendre's coefficients of the first and second kinds and the associated functions are treated in detail, their more important properties are developed, and their expression in the form of series and of definite

integrals is investigated. Solid harmonics are discussed fully, the addition theorem for ordinary spherical harmonics is established, and the connexion of the functions with potential theory is dealt with. The results given in this part of the treatise are sufficient for the solution of the problems of potential theory and of other branches of mathematical physics where the space under consideration is the space inside or outside the surface of a sphere or the space between two concentric spheres.

Spherical harmonics of general type are then discussed, the treatment follows the lines of the author's classical memoir on the subject, which was published in the *Philosophical Transactions* for 1896,\* and contains the principal results, including expressions for the functions in the form of series and of definite integrals, the further developments which have been made later are also taken account of. Asymptotic expressions for the Legendre functions are obtained, the order of the approximation in different cases is carefully discussed, and the same methods are applied to obtain the corresponding results in the case of the general harmonic functions. The representation of a function by a series of Legendre coefficients or of Laplace coefficients is fully investigated on the same lines as Fourier series have been treated in the author's treatise on functions of a real variable. The corresponding series which occur in the theory of potential when the space is not that between two concentric spheres might have been treated in much the same way. An interesting chapter is devoted to the addition theorem for general Legendre functions. The zeros of the spherical harmonics as functions of the argument and also as functions of the order are fully discussed, and this is followed by an account of the properties of the spherical harmonics which occur in the theory of potential and kindred problems in connexion with the ellipsoids of revolution, the anchor ring, the cone, and the spherical bowl. It may be noted that Mehler's functions are not the harmonics which occur naturally in problems of potential theory when the space has as part of its boundary a cone.

There is a short account of ellipsoidal harmonics which contains most of the results which are required in ordinary applications, reference to Green's work in this field in his memoir on the "Laws of Equilibrium of Fluids Analogous to the Electric Fluid" (*Camb Phil Trans*, 1833) might have been useful.

Ample references to the originals have been given.

\* "On a Type of Spherical Harmonic of Unrestricted Order and Argument"

throughout the book, and a useful index has been appended. The author is to be congratulated on his success in presenting the results of different investigators as a connected whole, and on having produced a treatise which will be the standard treatise on the subject for a long time.

### Mathematics for the Practical Man

*Mathematics for Self-Study Series* By J E Thompson (1) *Arithmetic for the Practical Man* Pp xiii + 269 (2) *Algebra for the Practical Man* Pp xviii + 291 (3) *Trigonometry for the Practical Man* Pp x + 204 (4) *The Calculus for the Practical Man* Pp x + 323 (London George Routledge and Sons, Ltd, 1931) 7s 6d net each volume  
(5) *Mathematics a Text-book for Technical Students* By Bevis Brunel Low Pp vii + 448 (London, New York and Toronto Longmans, Green and Co, Ltd, 1931) 12s 6d net

THE science of mathematics, the most fundamental of all intellectual activities, has been studied since the dawn of history, and almost certainly before that. The motives which impel this study are various, but it would scarcely be an exaggeration to say that everyone uses mathematics in one form or another. In the past, many of the advances of pure mathematics have been bound up with practical applications. For example, it is probably not often realised that the Gibbs phenomenon of Fourier series was brought into prominence by results obtained in using the harmonic analyser of Michelson and Stratton, and was at first attributed to an inaccuracy in the machine itself.

The fascinating study of pure mathematics for its own sake is an occupation which is of necessity confined to a few who have their own specialised literature available. The corresponding class of students of advanced applied mathematics are also catered for. But beyond these specialists there remain two other larger classes, those who are interested in scientific activities generally, especially such aspects as can be appreciated by a general knowledge of elementary mathematics, and those who regard mathematics as a working tool in their daily pursuits and wish to extend their knowledge for severely practical aims. To treat these as potential specialists in mathematics would be a great mistake, and it is only fair that literature should be available which will meet their needs.

The books listed above are essentially intended for the student who is interested in the meaning and simpler technique of mathematics but has no

teacher to help him. They are written in a pleasant and somewhat diffuse style so as to anticipate, so far as possible, the difficulties of those who have to follow a written explanation unaided. A paragraph from the preface of (2) deserves to be quoted, and points a moral which should not be overlooked by teachers of elementary mathematics.

"The book is rigorous in that it is scientific in its approach. It attempts to explain and not to side-step obstacles and difficult points. There can be no non-mathematical book on mathematics, and popularisation may only be gained through clarity of expression and through a human and common-sense approach with a minimum of formality."

An author who expresses this view demands respect, the more so since he has acted upon the principle here stated throughout the four books of the series.

The book on the calculus deserves special notice on account of its novel manner of approach, namely, by the method of rates and not by the method of limits. The idea of limit is of course implicit in that of rate, so that the student starts at a more advanced point than usual, but at a point which appeals to the practical mind and from which it is possible to obtain and employ the simpler results and methods without straining the reader's capability. This book has been written with amazing skill, and forms a fitting conclusion to a series which certainly fulfils the author's aim of catering for those who wish to obtain a practical mastery of some of the more usual and directly useful branches of mathematical science.

The books are well worth reading, they are eminently readable, and, in spite of the impression which might be conveyed by the titles, they do not make the main ideas subservient to practical problems. They have a wealth of fully worked examples and plenty of exercises.

(5) This book is of a rather different character from the foregoing, as it supplies a comprehensive course in analysis of a rather more advanced kind. It is intended for those who wish to make practical use of the subject in engineering, physics, chemistry, and other technical sciences. The author, however, does not call his subject "Practical Mathematics", for, as he justly points out, there is plenty of room for a difference of opinion as to what is practical. The book covers a wide range from simple equations to elementary differential equations. An excellent feature is the plentiful use of diagrams, of which there are 409. There are many well-chosen, worked examples and numerous exercises. The book can be recommended. L M MILNE-THOMSON

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is just possible that the delayed ovulation in these animals is correlated with the comparative absence of the light stimulus. However, the common bat does come under the influence of daylight to a certain extent, as may be seen even in mid-winter on any mild days. Thus, in January, which was notoriously mild, I observed bats in the late afternoon flying in the light of the setting sun, and Dr Rastall observed them at mid-day. Moreover, as described by Heape in his lately published posthumous book, several species of bats are migratory and 'follow the twilight'. With regard to the mole, it is well known that these animals do spend some time above the surface of the ground. For a description of their habits in this respect, Millais's book on the "Mammals of Great Britain and Ireland" may be consulted.

It is obvious, however, that although the principle enunciated by Dr Baker and Prof Bissonette is probably of extensive application, as shown by the general tendency for animals to breed in spring, the degree of response varies greatly for different species, and in some, possibly, scarcely any light at all is necessary. Furthermore, it is evident that the recurrence of breeding must depend upon other factors, of which the natural internal rhythm is most certainly one. The black swan and the *Cereopsis* goose in captivity in England, as well as other animals referred to in my "Physiology of Reproduction", illustrate this point.

It is interesting to note that Dr A. S. Parkes had at one time contemplated the possibility of light as a factor in determining the onset of reproductive activity, for, working with Miss M. Hill, he exposed two ancestrous ferrets to ultra-violet light but found that this had no effect on the sexual processes of the animals, a negative result on which he comments.<sup>1</sup> Mr S. Zuckerman, in his recent book, in describing this experiment, remarks that light appears to be an unimportant factor in determining the onset of sexuality, but he refers to Dr Baker's results in a footnote. Had Dr. Parkes made use of rays from the other end of the spectrum, as was done by Prof Bissonette for starlings, he would probably have obtained a positive result.

Lastly, it may be remarked that if any cogency is attached to the argument derived from the bat and the mole, it applies equally against the now universally accepted view as to the physiological action of ultra-violet light.

F. H. A. MARSHALL  
Christ's College, Cambridge,  
Feb 8

<sup>1</sup> *Proc Roy Soc*, 1930

#### Number of Free Protons in the Nucleus

WHEN one tries to establish a connexion between the nuclear spin and the number of protons (not bound in  $\alpha$ -particles) in the nucleus, one is led to examine the possibility that not as many protons as possible are combined as  $\alpha$ -particles, very suggestive in this respect is the case of bismuth (nuclear moment  $\frac{3}{2}\hbar/2\pi$ ), the nucleus of which may be assumed to be

$$A = 209 = 52\alpha + 1p + 22e \text{ or, as a first trial,} \\ A = 209 = 50\alpha + 9p + 26e$$

From a general point of view, one now would expect that in the neighbourhood of  $A = 100$  ( $A$  = atomic weight), one  $\alpha$ -particle must be assumed to be split up into protons and electrons.

This assumption has an influence on the energy of binding  $E_b$  of the nucleus, which is given by the equation

$$E_b = [n_\alpha m_\alpha + n_p m_p + n_e m_e] - A,$$

where  $n_\alpha$ ,  $n_p$ ,  $n_e$ ,  $m_\alpha$ ,  $m_p$ ,  $m_e$  are the numbers and the masses of the  $\alpha$ -particles, free protons, and free elec-

trons contained in the nucleus. In the following the term  $n_e m_e$ , as being small, will be neglected.

If one more  $\alpha$ -particle is assumed to be split up, the new value of the energy of binding will be

$$E_b' = [(n_\alpha - 1)m_\alpha + (n_p + 4)m_p] - A$$

This differs from the first expression by an amount of  $42.3 \times 10^{-6}$  ergs or about 0.030 mass-units ( $He/4$ ).

All this is well known.<sup>1</sup> It seems, however, that the above-mentioned assumption, when brought into relation with the curve of energy of binding for all

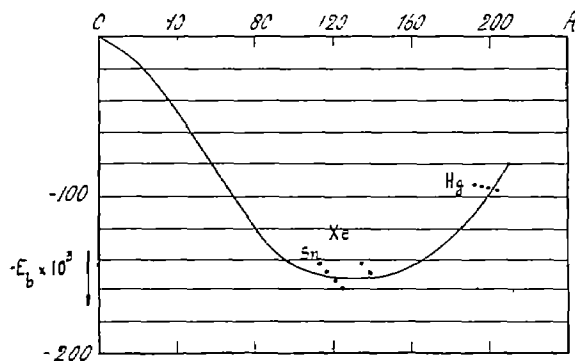


FIG 1

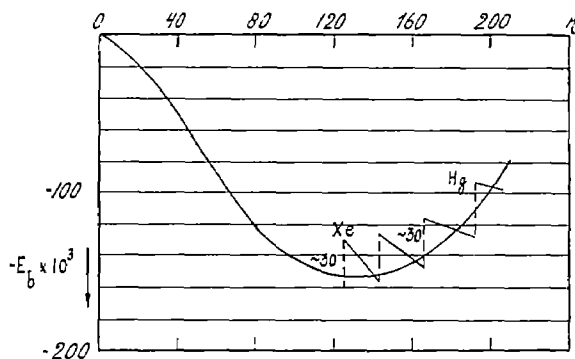


FIG 2

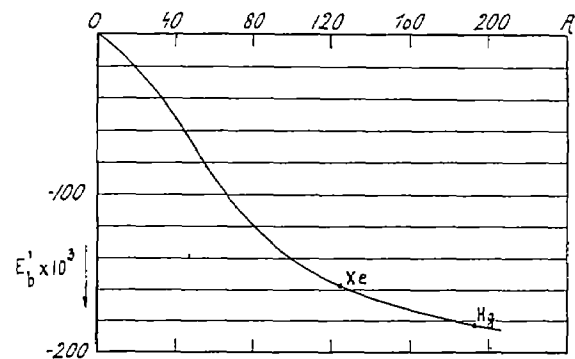


FIG 3

elements, may be of interest with respect to some difficulties one meets there. These difficulties are:

(a) The points representing xenon are very much off the curve.

(b) After xenon the curve goes up again, which means instability of all elements heavier than xenon.<sup>3</sup>

(c) Wherever in this second part of the curve a series of points has been measured, the slope of these local curves does not fit in with the general slope ( $Hg^{196}$ ,  $Hg^{200}$ ,  $Hg^{204}$ ,  $Pb^{208}$ ,  $Hg^{201}$ ,  $Bi^{209}$ ,  $Hg^{198}$ ,  $Hg^{202}$ ,  $Pb^{206}$ ,  $Hg^{199}$ ,  $Pb^{207}$ ).

(d) The points can best be represented by plotting separately the nuclei of the four different types with atomic weights  $4n$ ,  $4n+1$ ,  $4n+2$ , and  $4n+3$ . The difference between the ( $4n$ ) and the ( $4n+3$ ) curve is about 0.025 mass-unit.

These difficulties can be removed in the following way.

(a) In the case of xenon, one  $\alpha$ -particle is assumed to be split up into protons and electrons. Then the energy of binding increases  $\sim 0.030$  mass-unit and all xenon points fit the curve. (The same holds for  $\text{Mo}^{100}$ .)

(b) and (c) In the (unexplored) region between xenon and mercury the same assumption must be made again two or three times (as may be roughly estimated from the curve), so that the curve becomes smooth and goes continually downward.

(d) A highly speculative possibility is to consider the  $4n$ -nuclei of low atomic weight as ( $4n+4$ )-nuclei. Some support for this view may be provided by the general situation of the  $4n$ - and ( $4n+3$ )-curves,<sup>4</sup> and by considering the following table.

|        |                   |       |                   |       |                   |       |                  |       |                   |       |
|--------|-------------------|-------|-------------------|-------|-------------------|-------|------------------|-------|-------------------|-------|
| $4n$   | $\text{C}^{12}$   | 0.003 | $\text{O}^{16}$   | 0.009 | $\text{Ne}^{20}$  | 0.011 | $\text{Kr}^{84}$ | 0.117 | $\text{Sn}^{112}$ | 0.142 |
| $4n+3$ | $\text{F}^{19}$   | —     | $\text{P}^{31}$   | 0.032 | —                 | —     | —                | —     | $\text{Sb}^{115}$ | 0.108 |
| $4n+4$ | $\text{C}^{13}$   | 0.033 | $\text{O}^{16}$   | 0.039 | $\text{Ne}^{20}$  | 0.041 | $\text{Kr}^{84}$ | 0.147 | $\text{Sn}^{112}$ | 0.172 |
| $4n$   | $\text{Sn}^{112}$ | 0.148 | $\text{Hg}^{196}$ | 0.090 | $\text{Hg}^{204}$ | 0.094 |                  |       |                   |       |
| $4n+3$ | $\text{Sn}^{115}$ | 0.173 | $\text{Hg}^{199}$ | 0.113 | $\text{Pb}^{207}$ | 0.117 |                  |       |                   |       |
| $4n+4$ | $\text{Sn}^{116}$ | 0.178 | $\text{Hg}^{200}$ | 0.120 | $\text{Hg}^{204}$ | 0.124 |                  |       |                   |       |

(The missing values can be interpolated from the ( $4n+3$ )-curve.) If this were correct, one would have to ascribe to xenon eight (or perhaps even twelve) and to mercury as many as about twenty free protons, which would be of the same order of magnitude as the number of free electrons in the nucleus.

Some schematic diagrams may elucidate the ideas expressed under (a) to (c) as follows. Fig. 1, the ordinary diagram, must be given as Fig. 2, but ought to be interpreted finally like Fig. 3, in which more  $\alpha$ -particles are supposed to be split up.

When we return to our starting-point, the number of free protons in the bismuth nucleus, it appears to be of interest to investigate the mass defects of the rare earths, in order to make sure how many steps there are of the kind pictured in Fig. 2, in other words, how many  $\alpha$ -particles must be assumed to be split up in the bismuth nucleus.

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<sup>1</sup> Cf. *Ergebnisse der exakten Naturw.*, 9, 1930, F. G. Houtermans, "Neuere Arbeiten über Quantentheorie des Atomkerns", p. 123, especially pp. 188-191. Our Fig. 1 was taken from this article. G. Gamow, "Constitution of Atomic Nuclei", Chap. 1, pp. 14-16.

<sup>2</sup> F. G. Houtermans, *l.c.*, Figs. 10a-10d.

<sup>3</sup> See, however, F. G. Houtermans, *l.c.*, p. 197, and G. Gamow, *l.c.*, p. 20.

<sup>4</sup> G. Gamow, *l.c.*, p. 16, Fig. 3.

### Leadership and the Royal Society

YOU are constantly reproving scientists for neglect of their civic duties, our crime—for most of us will plead guilty—you seem to attribute to apathy. But the cure for apathy is usually leadership, and some of us think that your reproof would be more effective if it was directed to our natural leaders. Such, for example, is the view of "H. E. A.", who, in *NATURE* of Dec. 26, calls on the Royal Society to take the lead. You do not support him, because you consider (*NATURE*, Jan. 9) that the Society is hampered by its official connexions. That may be so, but the question remains whether the Society was wise to allow its hands to be tied, your excuse does not exonerate it, unless advising the Government and administering its funds is the most important function of the Society, to which all others should be sacrificed.

Inside the Society the most various views of its functions appear to be held. I have heard prominent fellows protest that it is still, as it was originally, a club for the social intercourse of congenial intellects, and that any public interest in its doings is impertinent. But outside there is no doubt at all. There it is held that the Society exists to recognise merit by the conferment of its fellowship—a title with a financial value that few older men can afford to disdain, and a moral value that inspires genuinely many of the ablest and keenest of their juniors. Any attempt to ignore this is simply disingenuous, for the belief that the Society is an accepted aristocracy of the scientific profession determines the conduct towards it of the whole outside world, scientific and lay. It explains why the Society, subject to so much hole-and-corner criticism, is so seldom openly attacked for a critic, if a non-fellow, lays himself open to a charge of envy, if a fellow, to a charge of disloyalty to his order. And—more important for the present purpose—it explains why it is impossible for any other body to assume the mantle of leadership, while the Society refuses either to wear or to discard it.

Whether this all-important function of the Society is compatible with its relations to the Government, I leave others to determine, noting only—for my business here is merely to say openly what so many say privately—that its recent action in choosing two Government servants for its officers has been widely condemned as an unnecessary riveting of its fetters. For my main contention is that the Society had already made it impossible for itself, or for any other body, to lead the scientific profession, by far more fundamental and disastrous practices. In the article on "Exposition and Authority" in *NATURE* of Jan. 30, much of the public failure to appreciate science is attributed to our jealous individualism and our unworthily narrow conception of personal merit. There is clearly, in the article, no thought of the Royal Society in this connexion, but I maintain that it is directly responsible. It has not, of course, created these original sins of the scientific temperament, but it has committed the equally serious crime of encouraging them, and has thereby made itself one of the main obstacles to the advance of the scientific outlook in this country.

I maintain, first, that the Society, by the demands it makes on candidates for election, sets up a standard of scientific merit that is false and unworthy in precisely the manner you describe. The whole practice of requiring applicants for a public distinction to expound their qualifications might be ridiculed, and I do not suppose that the Council actually pays much attention to the application forms. But it is obvious that if any evidence of scientific merit is demanded, that evidence will come to be regarded as the basis of election. Now, the only evidence demanded is a complete list of the candidate's scientific publications. He is not asked to give a general account of his work or to distinguish between the important and the trivial, no inquiry is made concerning his knowledge or interests outside the narrow range of his specialisation, his power of influencing colleagues, pupils, and the outside world by personal intercourse or 'popular' exposition is ignored, nothing matters (it is suggested) except an imposing list of strictly technical publications. Is it surprising, then, that our journals are filled with masses of unreadable trash, that sordid disputes about priority and credit rend the scientific world, and that the world outside still regards general imbecility and narrow-mindedness as the necessary accompaniment of scientific eminence?

My second, and more serious, charge is that the Society has allowed itself to become an aristocracy without the tradition of personal service, a form of institution that has destroyed every community in which it has arisen. Election to fellowship confers rights and privileges, it imposes no duties. Of course, many fellows have done and are doing noble work for science, but in recent times no fellow has been disgraced for dereliction of duty. That can scarcely be because the Society has never admitted a black sheep to its fold, many years ago I heard two young men declare that, once they had got their F.R.S. and a comfortable job, they would do no more research, and one, at least, of them has kept his promise. Is it surprising that science lacks leaders, that we are narrowly individualistic and lack the power of combination in defence of our common interests, when we so freely give and so willingly accept coveted distinctions without demanding or offering in return the smallest exertion for the general good?

It is not for me to suggest remedies, but perhaps I may indicate what kind of body the Royal Society of my Utopia would be. It would be a body truly representative of science, because election to it would be, not the conferment of an honour, but the recognition of honour already attained. Its members would be those who were already so widely respected in their profession that the assignment of a formal title could excite no jealousy. Each member would regard it as his duty and his privilege to serve his humbler colleagues, even at the expense of his immediate interests. *Noblesse oblige* would be his motto, and any self-seeking would be a confession of unworthiness of his rank, to be visited with expulsion.

The immense influence that such a position would inevitably give would enable these leaders of science to play in the councils of the nation and of the world the part that "H.E.A." assigns to them. But such a position could only be built gradually, and even if the Royal Society mended its ways to-morrow, a generation must probably elapse before it can play the great part to which its history calls it. Meanwhile, at the risk of an anti-climax, I want to make one very minor suggestion, partly because it is immediately practicable and partly because it illustrates so well the evils of our present state.

The commercial firm by which I am employed invites all genuine seekers after knowledge to ask for such advice and information as its scientific staff can give. Its motives need not concern us, the important fact is that a surprisingly large number of persons accept the invitation, including many (such as university students) who might be expected to find help nearer at hand. It is clear that the counsel and encouragement that beginners in research (or in research in some new direction) ought to receive as a matter of course from their seniors is not always forthcoming. I suggest that here is an opportunity for the Royal Society to display immediately the spirit that is needed to reform the scientific profession. Let it be publicly declared that every fellow regards it as his duty and his privilege to give advice to colleagues on all matters in which he is expert—to give it freely, without stint, and without any idea of recompense or credit. If it would at least consider that suggestion, the Society would show at last that it is still animated by the spirit of its founders, and that it still cares as much for the welfare of science as for the dignity of its fellows.

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No 3253, VOL 129]

### Cause of Twinning of Crystals

IN the course of an investigation<sup>1</sup> of optically active uniaxial crystals, I expressed the view that the possibility of twinning of a crystal was connected with a definite pseudo-symmetrical character of its structure as a whole. This statement was seriously attacked by Prof. Friedel, as may be clear from the following quotation of his paper<sup>2</sup>: "La formation de la macle est totalement indifférente à la symétrie ou à la pseudo-symétrie de l'édifice cristallin ou des groupes d'atomes qui le constituent. Elle est due uniquement à la rencontre de symétries ou de pseudo-symétries dans les *périodes* (mailles, simples ou multiples) de cet édifice."

With regard to this question, I should like to make some comments. The fact that, generally speaking, the influence of the forces exerted by atoms (ions) on the surrounding atoms (ions) does not extend over much more than their immediate neighbours, makes one inclined to believe that the fundamental cause of twinning must be looked for in the 'force-relations' in the immediate neighbourhood of the last-formed layer of the growing crystal.<sup>3</sup> These relations, which govern the addition of new atoms or ions, must be of such kind that the 'normal'—or the 'twin'—continuation of the structure represent growing-possibilities of nearly equal probability. For this reason it seems plausible to us to expect that they will show a (pseudo-) symmetrical character with regard to one or more definite directions in the crystal structure. This pseudo-symmetry, however, needs not necessarily show itself immediately in the positions of identical atoms, that is, in the pattern of the crystal structure, although there are instances where this is apparently the case, as, for example, with the twinning of aragonite<sup>4</sup>. It may also be due to a quasi-equivalence in the interatomic forces exerted by different atoms.

The undeniable experimental fact (see especially Prof. Friedel's beautiful book "Leçons de cristallographie", 1926) that in twin-crystals there is always a simple or multiple lattice unit underlying the whole twin structure is, according to my view, only another manifestation of a pseudo-symmetrical character of the structure of the untwinned crystal as a whole. To conceive it as the unique cause of twin-formation would imply the assumption, especially in the case of a twin with a relative high multiple-number of its underlying lattice, that at a certain stage in the growth of a crystal a new layer of atoms could take up the 'twin-orientation' only because, so to say, after the addition of some fourth or fifth layer, a certain number of atoms would occupy positions, which can be considered as lattice-points of a multiple lattice unit.<sup>5</sup> It leaves also unexplained, why two twin-possibilities of the same crystal, with equal multiple-number for their underlying lattice units and equal approximation of these units to exact periodicity in both parts of the twin, can show such a marked difference in occurrence that one of them is only rarely, the other frequently, observed (for example calcite, see Friedel, "Leçons de cristallographie", pp. 463-464), or why cubic crystals, which, while having identical lattice symmetry conditions, display great differences in twinning-multiplicity.

Without being able to give an explanation of these remarkable facts, I only wish to point out the necessity of assuming, besides the (pseudo-) symmetry relations of the lattices of the crystals in question, other factors playing a part in the formation of twins.<sup>6</sup> In this connexion attention may be directed to two very interesting papers, one by F. Heide (loc. cit.) and one by G. Aminoff and B. Broomé,<sup>7</sup> in which the authors arrive at the conclusion that in definite cases the faculty of twinning of a substance is apparently

connected with its faculty of being able to crystallise in more than one modification

With regard to the possibility of examining the structure of twinned crystals by means of X-rays, Prof Friedel fears<sup>8</sup> that the structure arrived at in this way will have an illusory value, in particular because it will relate to an incorrect lattice unit, namely, the lattice unit underlying the whole twin structure, which may be a multiple of the real unit cell of the untwinned crystal. While not in the least denying the presence of such a multiple unit, we deduced from our considerations<sup>9</sup> that, if indeed the X-ray investigator did find an incorrect unit cell, the danger would be greater that he would find a sub-multiple of the true cell than a multiple.

It is interesting to note that precisely this anticipation occurred in a recent X-ray investigation of crystals of the mineral boleite by B Gossner and M Arm,<sup>10</sup> who attributed to these crystals a cubic unit cell with side-length  $a = 15.40 \text{ \AA}$ . This statement was in contradiction with a crystallographic study of this mineral by Prof Friedel (dating from as early as 1906<sup>11</sup>), who from an examination of the cleavage of boleite crystals concluded that the cubic appearance is only a consequence of mimetic twinning of perpendicularly crossing biaxial quadratic lamellae with an axial ratio  $c/a$  very close to the value four. Now, from a careful X-ray investigation of a small untwinned birefringent fragment of a crystal of boleite, R Hocart<sup>12</sup> in Prof Friedel's laboratory could show that on his rotation photographs about the  $c$ -axis of the crystal some faint layer lines appeared, lying between those observed by Gossner and Arm, from which it followed that the  $c$ -axis of the unit cell of the untwinned crystal is  $62 \text{ \AA}$ , that is, practically four times as great as the  $a$ -axis. Without discussing in how far the weakness of these interadjacent layer-lines on Hocart's photographs is still an indication for the possibility of subdividing the true unit cell of boleite in four structurally closely related sub-cells,<sup>13</sup> their presence, on one hand, confirms beautifully Prof Friedel's prediction of the axial ratio of the untwinned crystal, on the other hand, it is in striking agreement with my own prediction about the danger of finding by X-rays a sub-multiple of the true unit cell instead of a multiple.

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<sup>1</sup> W G Burgers, *Proc Roy Soc., A*, 116, 553, 1927

<sup>2</sup> "Au sujet d'un Mémorial de M W G Burgers sur les cristaux uniaxes à pouvoir rotatoire", *Comptes rendus*, 186, 1788, 1928

<sup>3</sup> Compare, for example, the explanation of some twin structures exhibited by quartz crystals, by Sir W H Bragg and R E Gibbs, *Proc Roy Soc., A*, 109, 405, 1925

<sup>4</sup> W L Bragg, *Proc Roy Soc., A*, 105, 16, 1924

<sup>5</sup> Similar remarks have been made by F Heide, *Z Krist.*, 66, p 255, 1928

<sup>6</sup> It may be remarked in this connexion that even Prof Friedel himself, notwithstanding his definite statement about the cause of twinning quoted above, has made similar remarks in other passages of his treatises, as, for example, in "Leçons de crist", p 459

<sup>7</sup> *Z Krist.*, 80, 355, 1931

<sup>8</sup> "Leçons de cristallographie", pp 392-398, compare also *Comptes rendus*, 182, 741, 1926

<sup>9</sup> *Proc Roy Soc.*, loc cit, pp 560-561

<sup>10</sup> *Z Krist.*, 72, 218, 1929

<sup>11</sup> See *Z Krist.*, 73, 147, 1930

<sup>12</sup> *Z Krist.*, 74, 20, 1930

<sup>13</sup> Compare, for example, W H Bragg, "An Introduction to Crystal Analysis" (London, G Bell, 1928, pp 134 and following), also W T Astbury, *Proc Roy Soc., A*, 112, 448, 1926

### Polarisation of Downcoming Wireless Waves

In a method which has previously been used<sup>1</sup> for determining the state of polarisation of downcoming wireless waves, the frequency of a transmitter was varied so as to produce interference maxima and minima at the receiver in the well-known way. By analysing the signal variations at the receiver, it was

possible to deduce the state of polarisation of the downcoming waves. The method suffered from two disadvantages, as follows

(1) In order to interpret the results, it was necessary to assume that the intensity and state of polarisation of the waves had remained constant during the making of the frequency change. This restricted the observations to a period just before sunrise, when the downcoming wave was found to be sufficiently constant.

(2) It was possible to carry out the experiments only in conjunction with special transmitting stations such that the requisite frequency change could be made. This restricted very much the geographical locations of the transmitting stations.

We have now developed a method of observation which gives a pictorial representation of the state of polarisation on an oscillograph screen, and can be used to analyse the wave from any transmitter emitting a steady or a modulated wave. It may also be used when the nature of the polarisation is changing rapidly, so the two objections to the original method are removed.

In the new method, the normally polarised and abnormally polarised components of the downcoming wave are received on two separate aerial systems, and, after being amplified, are applied to opposite pairs of plates of a cathode ray oscillograph. The ground wave may be eliminated by the use of suitable aerial systems. The phase relations in the receivers are adjusted correctly by employing a small local transmitter placed in such a position that it induces into both systems. The sense of rotation of an elliptically polarised downcoming wave is determined by momentarily detuning one of the amplifiers slightly.

The apparatus has been used to investigate the downcoming waves from the London National transmitter received at Cambridge during the evening hours from sunset until midnight. The distance of propagation is 56 km and the wave-length 216 m. It is found that the type of polarisation changes very rapidly—an appreciable change taking place in half a second. The commonest form of polarisation observed approximates to a circle, but straight lines and narrow ellipses often inclined to the vertical plane of propagation are frequently observed. Although the type of polarisation varies considerably, it has been found that the sense of rotation of the figure is always the same. Observations on five different nights and on three different settings of the calibration apparatus have shown that the sense of rotation is anticlockwise if we look along the ray in the direction of travel.

These preliminary results therefore confirm the previous results of Appleton and Ratcliffe, and lend support to the theory outlined by them and recently mentioned by Prof Appleton.<sup>2</sup>

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<sup>1</sup> Appleton and Ratcliffe, *Proc Roy Soc., A*, 117, 576, 1928

<sup>2</sup> NATURE, 128, 1037, Dec 19, 1931

### Perception of Gravity by Roots of *Vicia Faba*

UNTIL recent years it was a generally accepted view that the region of perception of gravitational stimuli in roots was the extreme tip of the root. Cholodny,<sup>1</sup> however, performed experiments in which he replaced the root tip in maize by the tip of the coleoptile, and the fact that a positive curvature was still obtained suggested that the function of the root tip might not be so simple as had hitherto been supposed. More

recently, Keeble, Nelson, and Snow<sup>2</sup> performed experiments in which positive geotropic curvatures were obtained when unstimulated root tips were stuck on to stimulated root stumps which had been decapitated before stimulation

It was pointed out to me by Dr T A Bennet-Clark that opposite stimulation of root and stump would give more exact information of the functions of tip and stump in the perception of gravity Accordingly, four parallel series of experiments, using seedlings of *Vicia Faba*, were carried out, as follows (about forty seedlings being used in each series)

(a) A number of roots were decapitated and placed in a horizontal position in a damp chamber for 3-4 hours, after which these roots were re-headed with tips from other roots which had also been stimulated in a horizontal position for the same period of time These tips were stuck on in such a manner that the side of the tip which had been lowest during stimulation was exactly *opposite* the side of the stump which

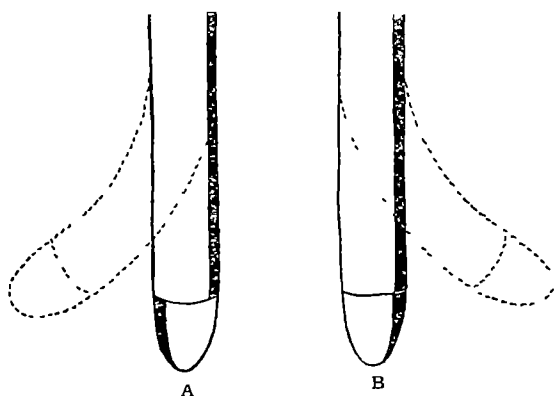


FIG 1—A—Diagrammatic representation of a root in series (a) B—Diagrammatic representation of a root in series (b) The thick black line indicates the under side of the root during stimulation, and the dotted line indicates position of root after response

had been lowest during stimulation (Fig 1, A) The roots were then placed in a vertical position

(b) A number of roots were treated similarly to those in series (a), but the new tips were stuck on in such a manner that the side of the tip which had been lowest during stimulation was on the *same* side as the side of the stump which had been lowest during stimulation (Fig 1, B)

(c) The roots from which the tips had been cut to re-head series (a) were also placed in a vertical position

(d) Normal roots were stimulated and then placed in a vertical position

The results obtained were as follows

Series a 67.5 per cent curved towards the side of the tip which had been lowest during stimulation  
15 per cent curved towards the side of the tip which had been uppermost during stimulation  
17 per cent remained straight

Series b 70 per cent curved towards the side which had been lowest during stimulation  
30 per cent remained straight

Series c 63 per cent gave a positive curvature  
37 per cent remained straight

Series d 70 per cent gave a positive curvature  
30 per cent remained straight

From the results of series (a), it can be seen that, in decapitation experiments with *Vicia Faba*, the root tip has a much stronger directional influence on response to gravity than the root stump The results of series (a) are seen to be significant, since the per-

centage response obtained in the control series (b), (c), and (d) is of the same order as that in series (a)

It is hoped that a full account of this work will be published later

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Feb 12

<sup>1</sup> *Ber deut bot Ges*, 42, 1924

<sup>2</sup> *Proc Roy Soc*, B, 105, 1929

### Molecular Structure of Cellulose and of Amylose

FROM the purely chemical properties of cellulose, recent experiments have enabled us to gain further information as to the nature and length of the cellulose chain It will be remembered that earlier work from this Laboratory showed that cellulose contains repeated units of  $\beta$ -cellobiose, and the present views on the intimate structure of this polysaccharide are based on these researches published in 1925-27

We have now obtained evidence that cellulose, in the form employed in our experiments, is a straight chain of limited length containing not more than 100 cellobiose units or 200 glucose units This represents a molecular weight of about 30,000 The lower possible limit is 25,000

This result was attained by preparing in one operation completely methylated cellulose from its acetate and submitting this to hydrolysis with aqueous hydrochloric acid at 0° The cleavage products from 200 gm yielded almost quantitatively the methylglucosides of the methylated glucose fragments, and by fractional distillation under diminished pressure, using a special column, a yield of 0.55 per cent of tetramethyl methylglucopyranosides was obtained. The remaining fractions consisted only of 2, 3, 6-trimethyl methylglucosides

Control experiments were conducted by distilling an artificial mixture of 2, 3, 4, 6-tetramethyl methylglucosides and 2, 3, 6-trimethyl methylglucosides and determining the quantity of the former which was separable This was found to be almost quantitative

It is clear, therefore, that in our specimen the cellulose chain was not endless, since to the extent indicated above, one of the glucose units formed an end group containing one more methyl residue than did the intermediate members It was thus possible to assay this component by quantitative methods, and hence determine the molecular size of the cellulose derivative This evaluation corresponds very nearly to that derived by Svedberg's method for the high polymeric forms of a number of natural products Dr H Machemer has collaborated with me in this work

Applying this procedure also to the amylose portion of starch, we have found that a much larger proportion (5 per cent) of the tetramethyl glucose component can be recovered by hydrolysis of completely methylated amylose This result, on the above interpretation, corresponds to only ten maltose units or twenty  $\alpha$ -glucose units in a chain which is not endless, or a molecular weight of not more than 4000. This conclusion is unexpected, and we are led to believe that similar experiments on the amylopectin portion of starch will yield a much higher value for the molecular size Dr E L Hurst, Dr M M T Plant, and Miss Wilkinson are specially identified with this work

We are reserving the application of this experimental method to glycogen, inulin, xylan, and other types of polysaccharides, and this work is already in hand

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Feb 18

## Research Items

**Australian Female Skull**—Prof F Wood-Jones points out in *Man* for February that the statement frequently made that 1000 cc is the lowest capacity occurring in skulls that can be classed as normal and human is erroneous. The female Australian skull is not only remarkably small, but also falls below this figure. It is due to this misconception that the discovery of a female Australian skull of 960 cc was hailed with such enthusiasm as having the lowest known cubic capacity of any human skull (MacKenzie). Hrdlička's average for 395 female crania is max length 179.4, max. breadth 127.6, basibregmatic height 127.4, modiolus, 144.8. Among these normally small-headed females there is a very definite element, especially in the central-northern and western portions of Australia, of unusually small-headed women. Sir William Turner, in his *Challenger* report (1884), found in 11 skulls an average cranial capacity of 938 cc, while in 30 adult Australian female skulls with a modiolus of 139 or less, which were measured by Hrdlička or the writer, the averages were as follows—max length 169.7, max breadth, 120.7, basibregmatic height, 121.9, modiolus 137.5. Although the capacity was not measured directly, some guide to the relation between the modiolus and the cranial capacity is furnished by the following correlations

| Designation of Skull | Modiolus | Measured Capacity |
|----------------------|----------|-------------------|
| M U Wimmara          | 132.3    | 900 cc            |
| Sir W Turner, avge   | 135.0    | 938 cc            |
| M U 54, 94, 5, 37    | 138.3    | 960 cc            |

The so-called 'Jervois' skull, which has no claim to antiquity, yields a modiolus of 139.3, and a cranial capacity, measured (MacKenzie) 956-980 cc. It cannot, therefore, be regarded as a remarkably small Australian skull. It exhibits no craniological characters which differentiate it from the accepted standards of the normal recent female Australian skull.

**Prehistoric Domestic Pottery from Southern India**—Mr L. A. Cammidge describes in the *Indian Antiquary* for February pottery from some ancient soak-pits found in old and now exhausted brickfields at Chetput, Madras. Fragments of pottery of urn-burial types were found scattered over an area of ten acres at the bottom of clay pits at a depth of 15-20 ft below the present ground level. They were derived from the bottom of silted-up wells which had been 24-30 inches in diameter. The wells had been constructed of pottery & in thick made in sections about sixteen inches in height, flanged at the base, and curved slightly inward at top. Wells of this type are not now made. In two wells examined there were about four feet of broken pottery mixed with bones. The pottery included fragments of large broad-mouthed pots of the usual urn types, and fragments of shallow oval or coffin-shaped troughs about twenty-four inches in length. There was also a large-necked pot of unusual type about thirty inches in diameter. Most of the smaller pots had globose bodies with narrow vertical rimless necks. Some had six holes at the base of the neck for suspension. Finally, there were fragments of polished red ring stands about ten inches in diameter. The importance of these types from the wells, or rather soak-pits, is that they represent domestic pottery—differing in certain respects from the funerary pottery—of the cist and urn-burial period, which has not hitherto been studied.

**'Flying Foxes' in Australia, and their Economic Significance**—The Australian Council for Scientific and Industrial Research, in *Bulletin* No 53, has published a work of extraordinary interest to the naturalist, embodying the results of co-operative investigations between different State departments, correlated and controlled by F. N. Ratcliffe. It is shown that, contrary to general belief, flying foxes (large bats of the genus *Pteropus*, some measuring almost four feet from wing-tip to wing-tip) are not a serious menace to the commercial fruit industry, and since the numbers are much greater than had been supposed, the serious control of the various species is regarded as beyond compass at reasonable cost. But we turn rather to the natural history of these bats. They live in 'camps', and a typical Queensland 'camp' during the day, when the animals hang asleep upon the trees, covered 5-10 acres of rain forest. When the camp rose for the night at 6 P.M. it formed a great column, about 100 yards wide and 100 feet deep in the centre, which continued to spue itself out of the trees continuously for 25 minutes. The number of bats was estimated (with great care) at about 220,000, and this was a small camp. A really large camp on Red River was half a mile wide and about four miles long, and the bats were present in millions. It seems likely that Australia was originally colonised by the bats by way of the Cape York route, but at a period remote enough to have allowed the specific differentiation of the five Australian forms.

**Parasites of the Wheat-Stem Sawfly in England**—The wheat-stem sawfly (*Cephus pygmaeus*) is of negligible importance as a pest of cereals in England. On the other hand, the closely allied western wheat-stem sawfly (*C. cinctus*) is a very serious enemy of the wheat crop in western Canada. The English species appears to be heavily parasitised, and it is likely that one or the other of its parasites might prove suitable for introduction into Canada. Little, however, was known respecting the economy of *C. pygmaeus* until the matter was studied by Dr G. Salt of the Imperial Institute of Entomology (*Bull. Entom. Res.*, Dec. 1931). As the result of his investigations he finds that several species of hymenopterous parasites attack *C. pygmaeus*, and one of them, the ichneumon fly, *Collyria calcitrator*, is of major importance. This insect attacks and destroys its host so heavily that it is evidently a highly important factor in the control of the stem sawfly under English conditions. Dr Salt describes the life-history and figures the larval stages of this and other *Cephus* parasites. From the economic point of view, however, the *Collyria* appears to be the only one of primary importance. Its perfect adaptation to and complete concentration on wheat-feeding *Cephus*—its independence of alternative hosts—its ability, as indicated by its wide range, to exist under different climatic conditions—all these factors give promise that its introduction into Canada will lead to beneficial results. This conclusion led to Dr Salt directing the collection of many thousands of *Collyria calcitrator* and their shipment to the Dominion Parasite Laboratory at Belleville, Ontario. The handling and transmission from Belleville to western Canada of this material was superintended by Mr C. W. Smith of the Dominion Entomological Branch. Liberations were made in suitable areas in Manitoba, and a short paper on the experiment is contributed by Mr Smith in the same issue of the journal already mentioned. Since the actual liberation only took place in 1930 it is pre-



mature to forecast its results. It is encouraging, however, to note that Mr Smith finds that the parasite has shown itself capable of attacking the Canadian *Cephus* and has succeeded in establishing itself.

**Potato Sickness**—The peculiar disease of potatoes known as 'sickness' has baffled students of plant pathology, but we have now a very definite pronouncement on the subject ("Potato Sickness", by W A Millard, S Burr, and L R Johnson, *Gard Chron*, Jan 9, 1932, p 28) as the result of co-operative study by the zoologists and botanists of the University of Leeds Agricultural Department. The cause of the sickness has been previously ascribed to two different fungus diseases as well as to eelworm injury, so the experiments under review were designed to test the effect of these three agencies, both singly and in different combinations. Photographs of typical plants which are published with the account show that only when eelworms (*Heterodera Schachtii*) were inoculated on to the plants did symptoms of 'sickness' appear. It seemed to matter little whether fungi were inoculated along with the eelworms or not, so it is concluded that the disease in question is caused by the latter agents. It is pointed out, however, that under field conditions the fungus *Corticium solani* may aggravate the malady.

**Cambrian Conchostraca**—E O Ulrich and R S Bassler have completed an important and detailed investigation of those small Cambrian Crustacea, most of which have been referred previously to the Ostracoda, in their publication "Cambrian Bivalved Crustacea of the Order Conchostraca" (No 2847 *Proceedings of the United States National Museum*, vol 78, art 4, 1931). The authors show that these certainly do not belong to that superorder but rather to the Branchiopoda. A scheme of classification is given which includes the Cambrian Conchostraca and allied genera, and it is suggested that the Ostracoda were derived from the earlier Bradonidae and Beyrichonidae. The chief differences are the position of the main muscle spot, the composition of the shell, and the incomplete separation of the valves. In the Bradonidae the margins of the valves, except along the back, are apart, the edges being so opposed that a narrow slit separates them. The illustrations to this monograph have been very carefully prepared, most of the figures being photographs which have been touched up slightly, the specimens having been whitened by the ammonium chloride process before being photographed. The result is excellent and the ten plates show up the specimens in a most satisfactory manner.

**Philippine Earthquake Epicentres**—The Rev W G Repetti, S J, Chief of the Seismic and Magnetic Division of the Manila Observatory, has written a valuable report on the epicentres of the Philippine earthquakes (1920-29) that lie north of Manila or lat 14° 30' N (*Manila Seismological Bulletin for 1930*, pp 71-85, 1931). None of the earthquakes considered was of destructive violence, though some were strong enough to crack walls. The earthquakes (300 in number) are divided into four groups according to the accuracy of the determinations. They lie almost entirely in the western part of Luzon and in the China Sea. The submarine epicentres lie along four lines, the most important of which is about twenty-eight miles off the west coast and in its southern portion is parallel to it. It lies along the eastern and steeper slope of the Abra Deep, a basin that rapidly descends to a depth of more than three miles.

**Uraninite from Henvey Township, Ontario**—H S Spence has described an occurrence of uraninite with thucholite, cyrtolite, and oily hydrocarbons from the

Besner pegmatite in the Parry Sound District (*Am. Mineral*, Nov 1930). Three analyses of the uraninite by H V Ellsworth appear in the same journal for last December. Among the results are the following

|           |       |       |       |
|-----------|-------|-------|-------|
| U         | 68.29 | 67.26 | 67.30 |
| Th        | 1.56  | 1.52  | 1.85  |
| Pb        | 8.04  | 7.51  | 7.57  |
| Pb        |       |       |       |
| U+0.38 Th | 0.117 | 0.111 | 0.111 |

The material has evidently been somewhat altered, but, in view of his work on the Villeneuve uraninite, Ellsworth concludes that the alteration of the Besner uraninite has not gone far enough to render the lead-ratio unreliable and that the true age is indicated by a value between 0.11 and 0.12. The granites with which the pegmatite is associated have been regarded by Quirke as Killarnean (latest pre-Cambrian granitic intrusions), but it is pointed out that whereas indubitable Killarnean granites have  $K_2O > Na_2O$ , the Henvey Township granite has  $Na_2O > K_2O$ . In this respect the latter granite resembles those of the Grenville sub-province for which lead-ratios of 0.15-0.16 are typical. It is therefore by no means certain that the Henvey granite is of Killarnean age.

**Selective Heating by Short Radio Waves**—The November number of the *Canadian Journal of Research* contains a paper by Prof J C McLennan and A C Burton in which a general theory of the heating of an object in the condenser of a high-frequency circuit is developed, and the essential result of the theory, that the action is selective for electrical as well as thermal reasons, is demonstrated by a number of ingenious experiments. With meat, the change in temperature was followed with a paint which changes colour on heating, and it was shown that different parts of this behaved quite differently on changing the wave-length of the oscillations from 10 metres to 25 metres. Eggs and chicken embryos were examined by a thermojunction method, and the white and yolk of a broken egg with a mercury-in-glass thermometer. The last case, again, showed a definite reversal of the effectiveness of this method of generating heat as the frequency was changed from 10 metres to 190 metres, and this was also found to occur with calves' liver and heart *in vitro*. The possible importance of this selective action in medical application must of course depend on the rapidity with which equalisation of temperature can be brought about in living tissues, and can only be settled by direct experiment.

**The Raman Effect**—The second December number of the *Physical Review* contains a valuable account from Prof R W Wood of his technique for producing Raman spectra by the light from a mercury arc. This is inferior in some ways to helium excitation, but is in general far more convenient, since mercury arcs are readily obtained from commercial sources. Prof Wood mounts the arc beneath the tube containing the substance to be studied, with intermediate colour filters, these appear to be essential if unambiguous results are looked for. The light is concentrated by making a liquid filter also serve as a cylindrical lens, and by having a metal reflector on top of the tube holding the substance under investigation. A critical account is given of the Raman spectra of a number of aromatic compounds, and the important observation is made that the presence of several faint lines which are now recorded with certainty for the first time apparently depends upon the actual wave-lengths used to excite them.

**River Pollution**—We have received the Report of the Water Research Board for the year ended June 30, 1931 (London: H M Stationery Office,

9d net) The report deals with the flow of water from the upper Tees and movements of water in the estuary and tidal portions of the river below Stockton, and the effects on plant and animal life, particularly fish. The death of fish caused by the water was shown to be partly due to toxic substances in the water, including phenol and other tar acids, hydrocarbons such as naphthalene, and in some cases cyanides in concentrations found to be lethal to smolts under experimental conditions. The breakdown of sewage in the river has also been studied. In summer the river purifies itself more rapidly and completely than in winter. In summer the river is practically purified about six miles from the point where the sewage enters, whilst in winter the self-purification may not be complete before the industrially polluted zone is reached. The Board puts forward suggestions for improving matters, among them that manufacturing processes should be modified so that no polluting effluents need be discharged. Several authorities in industry have, it is stated, expressed the opinion that in addition to avoiding pollution, the costs of making the necessary modifications for the re-use of part of the water are at least counterbalanced by the resulting economies.

**Tannins and Fatty Acids in Hops**—The true nature of the so-called tannin constituents of hops has always been a matter of doubt, but the results of work published in a recent series of papers by L.

Heintz (*Wochenschrift für Brauerei*, 48, 315-335, 1931) even imply that hops contain no true tannin at all. The hops were first extracted exhaustively with ethyl ether and then with 95 per cent alcohol, and the residue after evaporation of the extract, which constituted 15 per cent of the original weight, was tested for tannins. It was found to reduce Fehling's solution and to precipitate cinchonine sulphate solution, though on the other hand it contained about two per cent of nitrogen, whilst other tannin reagents gave inconsistent results. The cinchonine, ferric chloride, and other reactions for tannins are criticised, but it should be pointed out that so far as actual determinations of tannin are concerned the cinchonine sulphate method proposed by Chapman in 1907 has always given consistent and satisfactory results. Hops stored in warm surroundings sometimes develop rancidity, and the author suspected that this was derived from non-resinous substances, probably fatty acids, extracted in petroleum spirit from the stalks of the ground hops. He therefore separated them from the resins by esterification in ethyl alcohol, neutralisation, and removal from the resin soaps in petroleum spirit. As a rule, 1 to 2 per cent of fatty acids were obtained, according to the nature and age of the hop, about 90 per cent of which were soluble in petroleum spirit and appeared to be oleic acid, whilst the remainder contained saturated acids. In addition, about 1 per cent of neutral unsaponifiable matter was isolated.

### Astronomical Topics

**Atmospheric Changes and Climate**—Dr R. T. A. Innes contributes a paper on this subject to *Scientia* for January. He points out that the former presence of glaciers in many places that are now too hot for them indicates secular changes of climate. He considers that changes in the amount of solar radiation would be compensated by increased cloud formation, and would not greatly affect the surface temperature. He assigns more weight to small changes in the chemical composition of the atmosphere, especially to the percentage of carbon dioxide in it, the large amount of coal, etc., that is now burnt would have some slight effect on this percentage. Dr Innes thinks that some gas may have been introduced into the atmosphere by collisions with comets. The density of the comae of comets is known to be very low, so a very long period of time would be necessary for the introduction of any appreciable amount of gas from this source.

A Science Service Bulletin, dated Jan. 8, describes a study of the atmosphere and the importance to life of the small percentage of carbon dioxide, this is by Dr W. J. Humphreys, of the United States Weather Bureau. Carbon dioxide is essential to plant life, and that, in turn, is directly or indirectly the necessary food of animals. He further explains the importance of the layer of ozone in the upper air. If it were removed, the excess of ultra-violet radiation would be injurious to the eyes, while a great excess of ozone would stop all ultra-violet radiation, which would also have an injurious effect on life.

Dr Maud W. Makemson is making a research of a somewhat similar character at Rollins College, Florida (Science Service Bulletin, Jan. 12). The air in that district is free from contamination by smoke, etc., she takes advantage of this to collect meteoric dust in pans, placed on a high tower, "the fragments resemble volcanic glass or obsidian, while in colour they range from clear glass to amber." She

proposes to continue the research for some time, and to correlate it with the number of meteors observed in the different months by the American Meteoric Society.

**The Expanding Universe**—Mr M. E. J. Gheury de Bray contributes a note to *Astr. Nach.* 5844 in which he points out that Mr Van Maanen's photographs of the spiral nebulae appear to indicate both a rotational and an outward motion in the bright condensations in the outer whorls of the spirals. Van Maanen's results have been criticised as being probably too large, but they are likely to give the correct direction of motion. There is a difference of opinion whether the outward motion of the spirals as a whole extends to the individual members of each spiral, Prof. de Sitter holds that it does, Sir Arthur Eddington that it does not.

It will need a much longer time before Mr Gheury de Bray's suggestion of a general rotational movement of the system of spirals can be verified. In any event, it could be verified only if the angular velocity varied with the distance. He suggests that the angular velocity increases with the distance, but gives no reason to support this, and it appears improbable.

**The Red Spot on Jupiter**—This spot has been in existence at least since 1879, but has varied greatly in visibility, being at times scarcely traceable except by the bay that it produces in the neighbouring belt. Some drawings taken by M. R. Cheveau about a year ago are reproduced in *L'Astronomie* for January. The spot appears to have been plainly visible, though somewhat paler than the adjacent region of the belt. Two of the drawings show a dark stripe across the spot from north to south, suggesting a tendency to divide into two, the other two drawings do not show this stripe, though one of them is intermediate in time between those showing it.

## British Industries Fair

THE British Industries Fair, 1932, to which brief reference was made in our issue of Feb 20 (p 273), has again provided a most striking and significant visual demonstration of the extent, range, variety, and excellence of British manufactured products. It would be futile to attempt, within the limits of a short article, to review the exhibits shown at Olympia and the White City, in London, and at Castle Bromwich, in Birmingham. We must be content to note certain features, likely to be of special interest to readers of NATURE, of the scientific exhibits in the general section at Olympia. Before we come to particulars, however, it may be worth while to emphasise a point that was made last year in our review of the 1931 Fair.

The convenient arrangement of grouping the exhibits according to industries necessarily created a succession of mass effects, with the result that the visitor (who, it will be remembered, was primarily a buyer) could not escape receiving, even if only sub-consciously, a general impression of each particular industry as a whole. No visitor going through the Fair could fail to get, for example, from the china and glassware displays, a vivid impression of the vigour and efficiency of the respective industries, apart from, or rather in addition to, the individual effects created by the exhibits of the several firms. In this connexion the British scientific instrument manufacturers who displayed their products at Olympia are to be congratulated on having achieved, in this mass effect, a still further advance upon the very remarkable advance they made last year. They will do better still next year in the measure that the individual firms in the industry realise the importance of, and their responsibility for, creating a good psychological impression of what the industry as a whole is like.

To come to some of the individual exhibits, Adam Hilger, Ltd, demonstrated, among other things, the textile mutochrome and the blancometer. The mutochrome is a projection lantern device by means of which the colours and shades of individual portions of a pattern or design can be changed at will. Thus a large number of colour compositions of a design can be rapidly investigated and selection can be made of those most pleasing or appropriate for a given purpose. The instrument is finding increasing use in the textile industries. All the experimental work previously requiring the production on the loom of a collection of mixed patterns, from which choice might be made, can be done with the mutochrome in less time and without waste of material. The design is projected on a screen so that it may be viewed simultaneously by a number of observers, not only the colour but also the brightness of each element of the design may be altered independently, the colour variations being obtained by the use of colour filters, and variations of shade or brightness by means of calibrated iris diaphragms. The blancometer is an instrument designed for the accurate numerical specification of nearly-white colours. Its chief applications are to papers, fabrics, paints, powders, and other raw materials and products of industry where fine discrimination is required between nearly-white specimens. By its aid it is possible to measure accurately, without the interposition of a visual judgment, the amount of light of different portions of the spectrum reflected from a sample under test, compared against light reflected in precisely similar circumstances from a standard white surface.

Among the exhibits of Ross, Ltd, were an educa-

tional cinematograph projector for use in schools and institutions, and a new epidiascope. Special features claimed for the cinematograph projector are the great amount of light transmitted and the steadiness of the picture. Cooling by blower is so efficient that, with the full light on, the film can be stationary for hours without detrimental effects. It also embodies all the necessary precautions against fire prescribed by the L.C.C. regulations. A novel feature of the epidiascope is that it has a single lamp capable of yielding 500 watts or 1000 watts as desired. By the single movement of a lever the instrument can be changed from diascope to episcopes, or vice versa. The whole instrument is made to slide easily over the book or other object under projection, so that various parts of the object may be shown. The lenses for episcopes and diascope are anastigmats, and there are various attachments to facilitate micro-projection and standard film projection.

R. and J. Beck, Ltd, showed, besides types of their well-known microscopes, a high power binocular attachment for the microscope. It is claimed that the design of this attachment renders it suitable for use with any type of monocular microscope, without the disadvantage of increasing to any great extent the working height of the instrument. The optical principle permits as well any power of object-glass or eyepiece as any type of illumination to be employed. There were also to be noted a new pathological microscope and an eyepiece camera by this firm. To give great rigidity, the base and pillar of the microscope are in a heavy solid casting with large spread ( $7\frac{1}{2}$  in  $\times$   $5\frac{1}{2}$  in), enabling the microscope to stand firmly in either the vertical or the horizontal position.

The Thermal Syndicate, Ltd, exhibited a remarkable fused quartz celostat plano-mirror, eighteen inches in diameter. The blank had been manufactured by the firm and then ground, polished, and silvered by Sir Howard Grubb, Parsons and Company. Another noteworthy exhibit of the Thermal Syndicate was a vitreosil (pure fused silica) sunshine lamp. The lamp has been designed to provide a very close approximation to sunshine, including that proportion of ultra-violet radiation which is now known to have an important beneficial effect on human health. The approximation to true sunlight is produced by balancing the blue-green of the mercury arc with the correct amount of the light from gas-filled filament lamps, which has an excess of yellow and red. The vitreosil bowl of the sunshine lamp filters out the shorter ultra-violet rays, that is, below approximately 2950 Å, but allows the rays of the near ultra-violet, which are present in sunshine, to pass freely. Another effect of the vitreosil bowl is to eliminate glare.

Of the interesting exhibits of the chemical sections we must be content to mention two novelties shown by Imperial Chemical Industries, Ltd. This organisation has produced the 'pioneer partition block' for the construction of partitions in modern buildings, in the ways that breeze blocks are used. It is claimed that the mineral from which the blocks are made is highly standardised and unusually inert; it does not soften, move, or deteriorate with variation of humidity or with actual wetting, and, chemically, in the sense of attack on paints and pigments, it is safer than any other analogous material yet used. The other exhibit was a demonstration of the use of solid carbon dioxide as a refrigerant. This product, marketed under the name of 'Drikold' by the Imperial Chemical

Industries, Ltd., has a density 1.35-1.45, and evaporates slowly without melting, to give a tasteless, odourless, non-poisonous, and incombustible gas. It has a temperature of  $-110^{\circ}\text{F}$ , and is being largely used as a refrigerant in the ice-cream industry, in road and rail transport, and in the dairy industry.

Limitations of space preclude the mention of any of the many other scientific exhibits. One impression produced by these exhibits may finally be noted, namely, the growing application to industry of instruments previously regarded as appropriate only to the academic field.

### Scientific Publications in 1931

REFERENCE has been made from time to time in notes and articles in our columns to the ever-increasing flood of books and other publications with which scientific workers have to cope. Apart altogether from the question of expense—and that has become serious enough, as letters in *NATURE* a few years ago can testify—even the specialist has difficulty

in finding time to keep up with the literature of his own department of work. If any confirmation of these statements be required, it is given in Table I. This has been compiled from the monthly lists of "Recent Scientific and Technical Books" published in *NATURE* during 1931 and represents, roughly, a year's output of priced scientific and related publications; it does not include periodicals. The entries have been classified by subject and country of origin, and volumes actually received by *NATURE* for notice are marked by an asterisk. Turning first to the totals at the bottom of the table, it will be seen that the titles of 3227 publications were recorded in the *NATURE* Supplements during 1931, of which no less than 1357 were actually received at *NATURE* Office for notice. In-

TABLE I—TITLES ANNOUNCED IN *NATURE* SUPPLEMENTS IN 1931

| COUNTRY        | TOTALS | MATHS & PHYSICS | ENGINE'G | CHEM'Y | TECH'Y | ASTRON'Y | METEOR'Y | GEO'Y | GEOGR'Y | BIOLOGY | HORT' & AG'Y | ANAT'Y | ANTHRO'Y | PHILOS'Y | BACT'Y | MISC'Y |
|----------------|--------|-----------------|----------|--------|--------|----------|----------|-------|---------|---------|--------------|--------|----------|----------|--------|--------|
| ARGENTINE      | 1      | 1               |          |        |        |          |          |       |         |         |              |        |          |          |        |        |
| AUSTRIA        | 18     | 1 1             | 1        | 2      |        | 1        |          |       | 3       | 1       | 2            |        | 1        | 5        |        |        |
| BELGIUM        | 1      |                 |          | 1      |        |          |          |       |         |         |              |        |          |          |        |        |
| BRITISH        | 1488   | 99 85           | 66 53    | 79 12  | 21 47  | 6 3      | 22       | 32 6  | 37 165  | 154 62  | 38 37        | 53 14  | 75 24    | 94 57    | 18 9   | 113 7  |
| CHINA          | 3      |                 |          |        |        |          |          |       |         | 2       |              |        |          |          |        | 1      |
| CZECHOSLOVAKIA | 2      | 1               |          |        |        |          |          |       |         |         |              |        |          |          |        | 1      |
| DENMARK        | 3      |                 |          |        |        |          |          |       |         | 2       |              |        |          | 1        |        |        |
| ESTHONIA       | 2      |                 |          |        |        |          |          | 1     |         | 1       |              |        |          |          |        |        |
| FRANCE         | 173    | 31 14           | 4 24     | 8 10   | 2 11   | 3 2      |          | 1 1   | 2 9     | 11 5    | 1 3          | 4 3    | 11 5     | 2 2      |        | 4      |
| GERMANY        | 1138   | 22 85           | 3 118    | 32 165 | 5 74   | 2 9      | 10 11    | 17 48 | 4 123   | 50 120  | 1 35         | 3 48   | 2 35     | 4 96     | 10     | 1 5    |
| HOLLAND        | 11     | 1               |          | 1      |        |          |          |       | 5       |         | 2            |        | 1        | 1        |        |        |
| ITALY          | 16     | 4 3             | 1        | 3      | 1      |          |          | 1     | 2       |         |              |        | 1        |          |        |        |
| LATVIA         | 1      |                 |          |        |        |          |          |       |         | 1       |              |        |          |          |        |        |
| POLAND         | 2      |                 |          |        |        |          |          |       |         |         |              |        |          |          |        | 2      |
| ROUMANIA       | 1      | 1               |          |        |        |          |          |       |         |         |              |        |          |          |        |        |
| RUSSIA         | 3      | 1               |          |        |        |          |          | 2     |         |         |              |        |          |          |        |        |
| SIAM           | 2      |                 |          |        |        |          |          |       | 1       | 1       |              |        |          |          |        |        |
| SPAIN          | 1      |                 |          |        |        |          |          |       | 1       |         |              |        |          |          |        |        |
| SWITZERLAND    | 15     | 2 1             |          |        | 1      |          |          | 1     | 5       |         | 1            | 1      |          | 3        |        |        |
| USA            | 346    | 19 17           | 20 30    | 29 8   | 2 19   | 6 1      | 1        | 16 1  | 10 17   | 25 6    | 6 25         | 4 3    | 7 15     | 15 22    | 3 1    | 17 1   |
| RECEIVED*      | 1357   | 181             | 93       | 150    | 30     | 18       | 33       | 68    | 54      | 246     | 46           | 64     | 98       | 117      | 21     | 138    |
| NOT RECEIVED   | 1870   | 208             | 227      | 200    | 153    | 15       | 11       | 59    | 320     | 195     | 105          | 69     | 79       | 185      | 20     | 14     |
|                | 3227   | 389             | 320      | 350    | 183    | 33       | 44       | 127   | 384     | 441     | 151          | 123    | 177      | 302      | 41     | 152    |

in finding time to keep up with the literature of his own department of work.

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Turning now to the 'cross-totals', which show the numbers of scientific and technical publications issued by various countries, the lead is taken by Great Britain with 1488, but Germany makes a good second with 1138, the total for the United States is 346, and the aggregate for the other countries listed is 255. Thus, according to the titles shown in our Supplements, Great Britain is responsible for about 46 per cent, and Great Britain, Germany, and the United States together for about 92 per cent of the world's scientific and technical publications.

Table II has been compiled from the indexes of the last two volumes of *NATURE* and shows the number of publications actually noticed in our review columns during 1931. The subject classification here differs slightly from that in Table I, but will serve to

show that the number of volumes noticed in a particular field follows roughly the number published, thus mathematics and physics heads the subject list of publications both as regards number published and number received for notice, and a larger number of

TABLE II—BOOKS REVIEWED IN NATURE DURING 1931

|                                         | Jan-June | July-Dec | Totals |
|-----------------------------------------|----------|----------|--------|
| Agriculture, Forestry, and Horticulture | 9        | 7        | 16     |
| Anthropology, Archaeology               | 35       | 30       | 65     |
| Biology                                 | 66       | 41       | 107    |
| Chemistry                               | 27       | 55       | 82     |
| Engineering                             | 19       | 17       | 36     |
| Geography, Travel                       | 13       | 9        | 22     |
| Geology, Mineralogy, and Mining         | 12       | 17       | 29     |
| Mathematical and Physical Science       | 68       | 79       | 147    |
| Medical Science, Physiology             | 8        | 22       | 30     |
| Metallurgy                              | 3        | 7        | 10     |
| Meteorology                             | 7        | 2        | 9      |
| Miscellaneous                           | 31       | 29       | 60     |
| Philosophy, Psychology                  | 20       | 19       | 39     |
| Technology                              | 10       | 10       | 20     |
|                                         | 328      | 334      | 672    |

works on these subjects were noticed in our columns. It is also worth noting that while mathematics and physics claims 22 per cent of our review notices, biology comes second with 16 per cent.

The total number of publications reviewed during the year also requires comment. This number, 672, does not include the numerous references to publications made in "News and Views", "Research Items", "Astronomical Topics", "University and Educational Intelligence", and also in articles, many such publications are included in Table I. Hence we are justified in saying that considerably more than one-half of the publications received by NATURE are dealt with in our columns.

### Stock Diseases and Poisonous Plants

A PAPER upon the "Poisonous Action of Ingested Saponins", published as *Bulletin* 50 by the Council for Scientific and Industrial Research of the Commonwealth of Australia, has very general interest to stockbreeders and all who are interested in obscure diseases of stock in various parts of the world.

Prof A. J. Ewart, of the University of Melbourne, suggests that various obscure stock diseases of Australia, America, New Zealand, and South Africa, like the 'walkabout disease' of horses in Australia, may be caused by the saponins present in the tissues of plants on which the animals graze. In the case of the 'walkabout disease', Prof Ewart, in conjunction with Mr D. Murnane, in 1927, produced the disease in six horses by feeding them, for periods of a month or more, with *Atalaya hemiglaucæ*, a plant rich in a hæmolytic saponin. Later, however, Dr Seddon found that horses could be fed on fresh leaves of this plant for many months, in New South Wales, without any symptoms of disease developing.

Prof Ewart now shows that, whilst the plant grows abundantly down to the twenty-fifth parallel, 'walkabout disease' only appears north of the nineteenth parallel. The reason seems to be that in the more southerly latitudes this plant contains less saponin and more of a tannin which protects against the hæmolytic action of the saponin. Tests of saponins by intravenous injection or by hæmolysis experiments

are both difficult and expensive. Prof Ewart shows that very good evidence of the toxic nature of the saponin (or extract) under investigation may readily be obtained by the use of the water snail *Bulimus*. Only plants containing a relatively higher percentage of saponin are likely to prove toxic, and then under conditions providing for continued grazing on the plant, as the saponins do not dialyse readily and only a small fraction of the ingested saponin is absorbed in the alimentary canal. This percentage absorption is increased by the use of purgatives or by inflammation of the alimentary canal. Species of *Solidago*, *Aster*, and *Senecio* are amongst the plants suspected of producing diseases of stock from this cause, the percentage of saponin in the dry leaves varying from 2 to 8 per cent in these species.

The Winton diseases of horses and sheep in New Zealand, characterised in chronic cases by pronounced cirrhosis of the liver, can be produced artificially by continuous feeding on the ragwort, *Senecio Jacobææ*.

### Post-Glacial Prehistory in Ireland

OUR knowledge of the post-glacial prehistory of northern Ireland is summarised by Mr C. Blake Whelan in a recent communication to the Société Préhistorique française (*Bull.* 1931, 7-8). Although Chellean and Acheulean do not appear, it is possible to find in the gravels of north-east Ireland rare and doubtful specimens which appear to be humanly worked and may be examples of a pre-Mousterian, or even older, culture. The interesting Clactonian station of Rosses Point, Sligo, is an example. Yet up to the present, undoubted evidence of a true Mousterian of the Laufen interval between Wurm I and II appears to be lacking. Man may have retreated southward and not returned until the great glaciations had definitely retreated from Ireland.

The same uncertainty obtains regarding post-Wurm II. The only undoubted Aurignacian station is on Rathlin Island. There may also be a true Aurignacian tradition in the implements from below the ancient flood level of the lower Bann. Although of undoubted antiquity, it is difficult to bring such finished specimens into relation with the crude implements which follow. To the Buhl-Gshnits interval belong a series of a palæolithic industry of remarkable facies from the 50 ft raised beach of Antrim (see NATURE, July 26, 1930, p. 133), which may belong to a period anterior to the Baltic Lake. It may be a belated Magdalenian or a new industry, but it has nothing in common with the European microlithic culture extending from the Reindeer period to the Maglemose. The period in Ireland really corresponding to the Baltic Lake is found in the peat at the base of the deposits of the estuary of the Lagan (Belfast), which are covered by an ancient estuarine clay, itself underlying the gravels of the 25 ft raised beach.

In an analogous deposit at Larne is an industry thought to represent the final phase of the northern Magdalenian (see NATURE, Sept. 6, 1930, p. 352). In the 25 ft raised beach are found 'Asturian picks' mixed with a great quantity of roughly made implements which in the north are contemporary with the decline of the Magdalenian in the south-west. These may be the work of a race of pre-Mousterians driven north by the Aurignacians. At Glenarm is the pre-Campignian transition, and at Strangford Lough a number of stations mark the arrival of the true Campignian. Then comes the hiatus, followed by the neolithic and chalcolithic ages with their implements of classic upper palæolithic types, the final puzzle of the Irish stone age.

## University and Educational Intelligence

**BIRMINGHAM**—At the annual meeting of the Court of Governors held on Feb. 25, the vice-chancellor (Sir Charles Grant Robertson) stated that the University is making special efforts to forward the study of biology by increasing the supply of competent teachers available for schools and universities. He directed attention also to the highly successful work of the Appointments Board, the annual number of posts found by this board for Birmingham graduates having increased from 226 in 1924 to 346 in 1930, making a total of 1727, at a cost of about £100 a year. The economical working is due largely to the co-operation of the staff.

Prof. W. S. Boulton, professor of geology since 1913, is retiring at the end of the present session.

**CAMBRIDGE**—J. O. Girsavicius (Gonville and Caius College) has been appointed to the Benn W. Levy research studentship in biochemistry for one year.

**LONDON**—The following degrees have recently been conferred: D.Sc. (Botany) on Mr. M. A. H. Tincker, for seven published works dealing with the physiology of economic plants, together with four subsidiary contributions; D.Sc. (Physics) on Mr. F. H. Schofield, for eight published works on thermal conductivity and precision measurements of high temperatures, together with three subsidiary contributions; D.Sc. (Geology) on Mr. R. W. Pocock (Birkbeck College), for a thesis entitled "Contributions to the Geology of the West Midlands", consisting of four papers (*Geol. Survey*, 1921 and 1925, and *J. Geol. Soc.*, 1930–31).

THE result of the appeal made last year to former students of the Heriot-Watt College, Edinburgh, and friends and colleagues of the late Sir Francis Grant Ogilvie, the first principal of the College, has made possible the establishment of a Grant Ogilvie Memorial Prize Fund. The income of the Fund will provide two prizes, which will be awarded annually to the best students in the final years of the diploma course in electrical engineering and chemistry.

A NEW list of holiday courses in Europe has recently been compiled and published by the League of Nations Institute of Intellectual Co-operation, in three languages, English, French, and German (Oxford University Press, Warwick Square, London, E.C.4. Price 1s.). This list of courses open to foreign students contains all the essential information on 135 holiday courses to be held during 1932 in 17 different countries and 82 cities.

DOCTORATES conferred in the sciences by American universities are reviewed year by year for the National Research Council, Washington, and the titles of the theses, arranged under subject group headings, are published with statistical summaries in the Council's Reprint and Circular series. The review for 1930–31 shows that the number of these doctorates has increased steadily since the series began in 1920, from 330 conferred by 31 universities to 1147 conferred by 63. It provides data for what may, perhaps not too fancifully, be called the climatology of scientific research. Chemistry, as usual, claims a third of the aggregate of the labours of the new doctors—in Ohio State University, Columbia, and Illinois, one-half. Next to chemistry comes zoology, in which from fifteen to twenty per cent of the doctorates were conferred in California, Harvard, Johns Hopkins, Iowa State College, Michigan, Wisconsin, and Yale. Next in order come psychology, physics, botany, mathematics,

each of which is responsible for more than seventy doctorates, followed by physiology, agriculture, geology, bacteriology, pathology, engineering, and public health. Of the twenty theses on public health subjects, no less than sixteen belong to Johns Hopkins University. In the lists of titles, students will find indications of the lines of research favoured in America, that, for example, much of the research in psychology is concerned with observations of conditioned reflexes in white rats. Cancer research is conspicuous by its absence from the lists. Looking back over the records of ten years, the only important exceptions to the general increase by two hundred or more per cent in the number of doctorates conferred under the several subject group headings are physics (160 per cent), geology (170 per cent), and pathology (decrease by 4 per cent).

## Calendar of Geographical Exploration

March 7, 1778—Cook's Last Voyage

Capt. Cook reached the north-west coast of America in about lat.  $44\frac{1}{2}^{\circ}$  N. In the summer of 1776, Cook, in the *Resolution*, accompanied by Charles Clerke in the *Discovery*, had sailed on a voyage of exploration for the British Admiralty to the northern region of the Pacific coast of America, with the view of discovering a route thither via the Arctic. A few new islands were discovered in the Pacific, including the atoll named Christmas Island, where an eclipse of the sun was observed on Dec. 30. On Jan. 18, Hawaii was discovered, and the group was named the Sandwich Islands, after the Earl of Sandwich, who had done so much to encourage Cook's explorations; the Spaniards had probably visited the group in the sixteenth century. The coast of America north of  $40^{\circ}$  N. was practically unknown before Cook's visit. His vessels anchored in Nootka Sound, and thence proceeded north, naming islets and inlets as they went. Cook's Bay was thoroughly explored, and conclusive proof was obtained that no passage through to Hudson's Bay existed. The coast of the Alaskan Peninsula was surveyed, and Cape Prince of Wales reached and named. Crossing the strait to the Asiatic side, Cook made acquaintance with the Chukchee, returned to the American side, and pushed north to Cape Lisburne. Ice on both coasts and in the open sea compelled the vessels to return. On the west coast of Hawaii, Cook was murdered by the natives. Capt. Clerke took charge and decided to continue Cook's work in the northern Pacific, but he died on Aug. 2, 1779, and was buried at Petropavlovsk (Kamchatka). The vessels then returned, reaching the Nore in 1780. Cook's previous voyages contributed so much to exploration that his remarkable achievement in these northern regions is sometimes overlooked.

March 7, 1925—Eastern Bolivia

Col. P. H. Fawcett, leading an expedition to explore eastern Bolivia, reported from Cuyaba, Brazil, that his party was fit and his instruments were in good condition. Fawcett stayed at Cuyaba until April 20, and thence started on his proposed exploration of the Xingá, Araguaya, and Tocantín regions. A dispatch, dated May 30, 1925, from a camp in lat.  $11^{\circ} 43' S$ , long.  $54^{\circ} 35' W$ , was the last that was heard of him and his son and a young Englishman, R. Rimell. G. M. Dyott left for Brazil in 1928 to search for the party, and succeeded in crossing from Cuyaba to the Kulisehu River and thence reached the Xingu, following it to the Amazon. His journey was a remarkable feat of exploration, but it failed to find Fawcett and his party, and Dyott concluded that they had been



murdered by Indians. Fawcett's previous work had included many explorations in Eastern Bolivia, and he had acted as chief commissioner on the Bolivia-Brazil boundary commission in 1906.

March 9, 1914—Capt Shakespear in the Arabian Peninsula

Capt Shakespear reached the Malham oasis, previously unvisited by Europeans. He left Koweit in February, determined to penetrate into the heart of the desert peninsula of Arabia and to cross it from the Persian Gulf to Egypt. He covered some 1200 miles of unknown country, and for the whole of his journey he kept up a continuous route traverse, checked by observations for latitude, he also took hypsometric readings for altitude. Thus for the first time a complete traverse of the lower Wadi er Rumma was achieved, the first reliable map of the Tuwaik settlements was made, and a new route from Buraida to Jauf followed. From 1909, when he was appointed political agent at Koweit, Shakespear had made annual excursions into the comparatively unknown hinterland, and these paved the way for his last journey. In 1915 he was killed in a skirmish between the forces of Ibn Saud and his rival Ibn Rashid.

## Societies and Academies

### LONDON

Royal Society, Feb 25—D M Needham, J Needham, E. Baldwin, and J Yudkin. A comparative study of the phosphagens, with some remarks on the origin of vertebrates. Arginine phosphate exists in all the invertebrate phyla of which representatives were studied, though in the coelenterates it was only found in a ctenophore. This compound may be associated with ciliary as well as muscular movement. Creatine phosphate is not confined to the vertebrates, but was found in echinoderm jaw muscle and enteropneust tissues. If any evolutionary significance may be attached to these findings, it is probable that they support the echinoderm-enteropneust theory of vertebrate descent (Bateson, MacBride, Garstang).—G Philips. Myotatic reflexes in sympathetomised muscle. After excision of its sympathetic innervation, skeletal muscle exhibits quantitative changes in proprioceptive reflex activity. Simultaneous myotatic contractions of two soleus muscles when subjected to the same passive stretch have been recorded by a 'double' isometric myograph and a twin string galvanometer. Three conditions of stretch-stimulation have been regarded as essential in making comparable records. These are, a small passive increment of length, performed at an even rate, from an initial posture of minimal tension. Under such conditions the latent period of the myotatic reflex determined by the time of onset of the first action current wave is shorter in the sympathetomised muscle. Soleus muscle deprived of its sympathetic innervation some weeks previously loses in great degree its power of maintenance of any postural contraction of other than low tension. The available evidence denies the existence of any sympathetic nervous mechanism responsible for the direct qualitative control of postural reactions, and suggests quantitative changes following sympathetomy are produced by a disturbance of the excitability of proprioceptive end-organs in sympathetomised muscle.—J C Eccles and H E Hoff. The rhythmic discharge of motoneurons. The events during the rhythmic cycle are described in terms of the 'activity' of the rhythmic centre, by which is meant the propensity of the rhythmic centre to set up a reflex discharge.

Geological Society, Jan 13—F B A Welch. The geological structure of the eastern Mendips. The area discussed comprises the Beacon Hill pericline, the most southerly situated of the four echeloned Mendip periclinal and that bordering the Radstock coalfield. As in the other three cases, the structure is anticlinal with a steeply folded north limb, the core is formed of Old Red Sandstone and Silurian, the Avonian outcropping on the flanks. The south limb is much concealed by Mesozoic strata, which also stretch across the eastern part of the area, so that the Avonian can only be seen in deep ravines. The whole sequence of events appears to have been the northward drive of the east-and-west pericline against the southern 'nose' of the coal measure basin (with a north-and-south axis). Maximum resistance was offered to this movement along the line of this axis, and in this line lies the central fault block—E S. Hills. Upper Devonian fishes from New South Wales. The greater part of the material comes from Harvey's Range, north-north-east of Parkes, but there is a single specimen from the Jemalong Gap, another single specimen from the western flank of the Canoblas Mountains, and a few plates preserved in limestone from an unknown locality. The faunal list is enumerated. *Remigolepis* is a new genus lately erected by Stensio to embrace remains found in East Greenland, and its presence in the collection was recognised by him. Not only does the present record of Upper Devonian fishes from New South Wales greatly extend the known range of these forms in south-eastern Australia, but also it affords valuable evidence for the correlation of the Devonian rocks of that district. It is suggested that the shallow marine deposits of the Lambian (Upper Devonian) series may be, in the main, older than the continental deposits of that epoch, and that the Upper Devonian rocks of Victoria may be the equivalent of only the top of the series as it is developed in New South Wales.

Physical Society, Jan 15—Shih-Chen T'ao and William Band. Some thermomagnetic effects in nickel and iron. The paper relates to the production of an e.m.f. in nickel and iron wires by the simultaneous application of a longitudinal magnetising field and a temperature gradient.—W A Leyshon. On periodic movements of the negative glow in discharge tubes. The effect is produced when traces of hydrocarbon vapour are present in the tube in addition to the filling gas (neon, in most of the experiments here described). The jumping glow may be due to internal flashing at that part of the surface of the cathode which is not covered by negative glow. The flash may be caused by the electrical breakdown of a partially insulating hydrocarbon layer, as a result of the collection of positive ions, or by a surface chemical action occurring when the reaction products of the discharge have reached a certain concentration at that surface. It is supposed that the electron emissivity of the surface is increased by the flash, and that the main glow jumps to the activated surface. The process is reversible and hence may be periodic.—G I Finch and R W Sutton. A cathode-ray oscillographic method of measuring inductance. The voltage fluctuations across the condenser in a damped oscillatory circuit, comprising inductance, capacity, and resistance, are recorded by means of a cathode-ray oscillograph.—H R Nettleton and F H Llewellyn. On the measurement of electrical resistance in terms of a mutual inductance and a period. It is shown that if the ratio  $a/a'$  of the radii of the concentric circles forming a simple inductometer is 0.50607, the mutual inductance is so accurately proportional to the angle through which the turning coil is displaced that the rising deviation from a linear law is

less than 5 parts in a million at  $7^\circ$  of deflexion. If the outer circle is replaced by two twin circles which are separated symmetrically with regard to the turning coil, the ratio  $a/a$  must be increased to bring about a similar approach to linearity. If a heavy dynamometer is constructed on this principle, then, over the range indicated, the deflecting couple is strictly proportional to the current-products.

## PARIS

Academy of Sciences, Jan 18—E Jouguet Cooled diffusors—L. Cayeux The interpretation of the deposits of magnesian limestone of Bimont (Oise) and of Étretat (Seine-Inférieure) The magnesian formations at Bimont and Étretat have important characters in common. Both appear to have been caused by a local modification of the submarine medium. The hypothesis of modifications of the original limestones by the action of mineral springs charged with magnesium salts can be dismissed—Charles Achard and Maurice Piettre Some physical and chemical properties of the mucine of the synovial articulations—André Blondel Calculations concerning high voltage lines with use of transformers—A Recoura New researches on the hydrated chromic chlorides. Starting with ordinary chromic chloride, usually considered to be  $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$ , and drying in a vacuum for three to four days, anhydrous ether extracts a brown chloride which is probably  $[\text{Cr}(\text{H}_2\text{O})_3\text{Cl}_3]$ . A second method, using acetone, is also given for preparing the brown chloride—Rene Maire and Louis Emberger The vegetation of the Anti-Atlas—Ch Porcher and L Jung The intensity of the mammary circulation in the goat during lactation—Gaston Julia The structure of multiple convex areas—Radu Badescu Certain uniform transcendental functions represented by series of rational functions—Jean Pierre Robert The generalisations of a singular integral equation of H. Lebesgue—Lars Ahlfors A generalisation of Picard's theorem—Henri Poincaré Elliptic cavitations—A Guerbulsky Recording the deformations and vibrations of the wing of an aeroplane in flight—A Danjon The apparent displacement of the stars in the neighbourhood of the eclipsed sun. A discussion of the observed results compared with those predicted by the theory of generalised relativity—Ernest Esclangon Remarks on the preceding paper. The deviation observed is the result of an extrapolation, and the question cannot be regarded as definitely settled without many additional observations—L Brillouin The statistics and magnetism of the free electrons—Paul Le Rolland and Tchang Te Lou A new electrical method for the determination of the dew point, applicable to thermal machines. The method is based on the fact that when water vapour is condensed on the surface of an insulator, the latter becomes conducting. The change in the resistance of the surface can be arranged to produce a sound in a telephone or to illuminate a neon tube—M Pauthenier and Mme M Moreau-Hanot The study of the motion of a heavy sphere in an ionised electric field—L Néel The magnetic susceptibility of iron some degrees above the Curie point—Felix Esclangon The realisation of monochromatic sources of red and yellow light. With tubes without electrodes containing mercury, sodium, or cadmium, the high frequency discharge takes place at temperatures of  $80^\circ\text{C}$ ,  $250^\circ\text{C}$ , and  $260^\circ\text{C}$  respectively. If some argon (pressure of the order of 0.1 mm) is introduced into these tubes, mercury lights up at the room temperature, sodium at  $180^\circ\text{C}$ , and cadmium at  $200^\circ\text{C}$ . These facts can be applied to simplify the production of monochromatic light—J P Mathieu The optical properties of 1,4-naphthalene-bisimino-camphor—Constantin Salceanu The

variation with the temperature of the magnetic double refraction of some aromatic compounds in the fused state—Mme. Irène Curie and F Joliot The emission of protons of high velocity by substances containing hydrogen under the influence of very penetrating  $\gamma$ -rays—M Haissinsky The electrolytic deposit of polonium in an alkaline medium—Desmaroux and Mathieu The structure of nitrocellulose films—Henri Muraour A theory of explosive reactions—Jean Challansonnet The constitution, spontaneous graphitisation, and thermal hysteresis of low carbon cast iron containing titanium. Silicon and titanium modify the characters of cast iron in the same direction. Both favour the formation of graphite on solidifying and on annealing. They also reduce the thermal hysteresis of the change ( $\alpha$ -iron  $\rightarrow$  C)  $\rightarrow \text{Fe} + \text{Fe}_3\text{C}$ —M and Mme Leclère The separation of the thiophene hydrocarbons contained in oils with high sulphur. A method of controlled sulphonation followed by hydrolysis of the thiophene sulphonic acids was found to be the best method of separation.—R Lespieau Study of a method of preparation of true acetylenic primary alcohols. Description of the properties of the alcohol  $\text{HC} \equiv \text{C} (\text{CH}_2)_2 \text{CH}_2\text{OH}$  and of some compounds derived from it—Roger Dolique The influence of some impurities on the critical temperature of the solution of phenol in water. Impurities in the phenol of the order of 0.1 per cent may cause differences of  $0.2^\circ$ – $0.66^\circ\text{C}$  in the critical solution temperature—Houllier The formation of travertine and peat in the Somme valley—H Arsandouy The morphological evolution of the dome of Mt Pelée—Francis Ruellan The transversal deformations in the relief of the Japanese Archipelago—Henri Coupin Loss of sexuality by a fungus—Bogdan Varitchak Nuclear evolution in *Pericystis apis*—Obaton Mantol as food for *Sterigmatocystis nigra*—D Montet The action of weak radioactivity on the germination of seeds. Black oxide of uranium was used as the radioactive material. Each kind of seed showed an effect, with an optimum varying with the nature of the seed and its surface—A Perrier Researches on the fermentation of coffee. From the results of experiments detailed it is concluded that the fermentation of coffee is not essential for the preparation of a fine product. On the contrary, if the fermentation is prolonged there is a prejudicial effect on the colour and aroma. Hence the fermentation of coffee is on a different footing from cocoa and tobacco, where the fermentation would appear to be indispensable—N Liatsikas The presence of brown steppe soils in the plain of Thessaly—A Demolon and Mlle J Brigando The fixation of proteins by the soil—Louis Fage The seasonal vertical migration in the Mysidaceae—Mlle M Gex Remarks on the neutralisation curves of biological systems, and of sera in particular—R Legroux and Kemal Djemil Transmissible lysis—A Trillat Attempts at vaccination through the air (chicken cholera)—Jean Regnier, Robert David, and Mme Alice Kaplan Contribution to the numerical study of microbial multiplication. The existence of the latent phase—C Levaditi, J Bardet, A Tchakirian, and A Vaisman The therapeutic properties of indium in trypanosomases and in experimental syphilis. Indium resembles gallium in its active therapeutic action in certain trypanosomases and experimental syphilis. Its preventive and curative activity is satisfactory in the infection produced in mice by *Trypanosoma Evansi*, but is uncertain in the treponemosis of the rabbit (*Treponema pallidum*).

## ROME

Royal National Academy of the Lincei Communications received during the vacation, 1931—G A Crocco Aerothermodynamic bodies—N Parravano

and V Caglioti Alloys of zinc and manganese X-ray investigation of these alloys reveals the existence of  $\gamma$ ,  $\epsilon$ , and  $\eta$  phases with structural characteristics analogous to those of the brasses The hexagonal  $\epsilon$  phase is stable at ordinary temperature over the range 33-24 per cent of manganese, and the cubic  $\gamma$  phase, with 52 atoms in the unit cell, has a region of existence between 22.26 and 8.09 per cent of manganese and is stable at the ordinary temperature The  $\eta$  phase, composed of solid solutions of manganese (about one per cent) in zinc, is unstable and, as it ages, undergoes de-mixing with formation of a eutectic of zinc with another phase ( $\gamma'$  or  $\beta'$ ), probably cubic—P Rondoni and G Mezzadrolì Action of ultra-short electromagnetic waves on the transplantable adenocarcinoma of the rat These waves accelerate the growth of the tumours considerably—G Barba Generalised parallelism in a  $V_3$  (2)—G Krall The adiabatic invariant in the free motion of gyroscopes—A Rosenblatt The stability of laminar movements of viscous liquids (2) Exponential damping at infinity—E Oddone A contribution of seismometry to the history of the earth Seismometric evidence supports G H Darwin's hypothesis of the birth of the moon by tidal action exerted by the sun on the earth—V Ricca Raman spectrum of ammonia in solutions of different concentrations Aqueous solutions of ammonium salts exhibit no Raman line attributable to the  $\text{NH}_4$  ion, and aqueous ammonia shows a Raman spectrum identical with that furnished by liquid ammonia It may, therefore, be concluded that, in aqueous solution, ammonia exists partly as  $\text{NH}_3$  and partly as  $\text{NH}_4\text{OH}$ , the reaction  $\text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_4\text{OH}$  representing an equilibrium—F De Carli Viscosity of mixtures of stannic chloride with aromatic hydrocarbons (2) At ordinary temperatures, homologues of benzene exhibit a distinct tendency to associate with stannic chloride Such associations, which are detectable only in the liquid state and are almost completely destroyed at  $30^\circ$ , behave similarly to the compounds of the same hydrocarbons with sulphur dioxide Confirmation is obtained of the view that the substituent groups of the benzene ring contribute markedly to the greater stability of the complexes formed by derivatives of aromatic hydrocarbons—V Famiani The beri-beri quotient ( $Q_b$ ) in nutrition with polished rice and autoclaved grain Experiments with the same experimental animals (pigeons) fed with polished and washed rice, or grain autoclaved either dry or moist or in presence of alkali, reveal no substantial differences in the values of the beri-beri quotient or in the symptoms observed—G Amantea and V Famiani The possibility of obtaining permanent beri-beri phenomena in the pigeon by deprivation of the  $\beta$  factor—A Baroni Solid solutions between alkali halides X-ray investigation of the system  $\text{KCl-KI}$  fails to show even partial miscibility between the two salts in the solid state The results of thermal and X-ray analysis of the systems  $\text{KCl-KBr}$  and  $\text{KBr-KI}$  confirm those of other authors and show that a metastable equilibrium is reached, true equilibrium being attained only from aqueous solutions—V Zagami The effects on albino rats of feeding with seeds of *Lathyrus sativa* L alone These seeds form an incomplete or a qualitatively deficient food for growing rats Although no nervous or motor phenomena related to those described as lathyrism were observed, the young rats displayed diminished resistance, torpor, and pronounced slowness in growth, more particularly of the genital organs and skeleton—G B Cacciamali Contortions of the Ercinian in Alpine orogeny—G Mezzadrolì and E Varetton Influence of Italian

radioactive soils on the development of silkworms Exposure of silkworms to these soils exerts a favourable action on the development of the worms, their growth being enhanced so as to increase the weight by 32-45 per cent, and the weight of the cocoons increased by 5.8 per cent—Celso Guareschi Fusion of otocysts in xenoplastic grafting between Anura and Urodela—Teodoro Perri Behaviour of optical vesicles of *Triton* grafted on to embryos of *Rana esculenta* (destructive processes and power of recovery) (2)—M Curzi Cases of pedal gangrene from *Sclerotium* observed in Italy

## Forthcoming Events

### FRIDAY, MARCH 4

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society) (Annual General Meeting), at 3—Presidential Address  
INSTITUTE OF MARINE ENGINEERS, at 6—Annual General Meeting  
GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7.30—Prof W G Fearnside The Carboniferous Rocks of Derbyshire Derwent (Lecture)—W Pulfrey On the Occurrence of Radiolarian-bearing Nodules at the Base of the Edale Shales, near Calver, N Derbyshire (In Abstract)  
ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Sir Harold Hartley Michael Faraday and Electro-Chemistry

### SATURDAY, MARCH 5

ROYAL INSTITUTION OF GREAT BRITAIN, at 3—Lord Rutherford of Nelson Discovery and Properties of the Electron (2)

### MONDAY, MARCH 7

ROYAL INSTITUTION OF GREAT BRITAIN, at 5—General Meeting  
UNIVERSITY OF LEEDS, at 5.15—Prof H J Fleure Races and their Evolution (Lecture)  
UNIVERSITY COLLEGE, LONDON, at 5.30—M Jacques Maritain Quelques Aspects de la philosophie Thomiste (Lecture) (in French)  
ROYAL SOCIETY OF ARTS, at 8—A E L Chorlton Oil Engine Traction (Howard Lectures) (1)  
ROYAL GEOGRAPHICAL SOCIETY, at 8.30—Sir Douglas Mawson The B A N Z Antarctic Research Expedition, 1929-31

### TUESDAY, MARCH 8

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5—Dr L J Witts The Pathology and Treatment of Anæmia (Goulstonian Lectures) (3)  
INSTITUTE OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30—Annual General Meeting  
INSTITUTE OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Literary and Philosophical Society, Newcastle-upon-Tyne), at 7—Prof J K Catterson-Smith Everyday Uses of Electricity (Faraday Lecture)  
PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30—F Wokes The Importance of Ergot in Pharmacy (Lecture)

### WEDNESDAY, MARCH 9

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 A.M.—Reading and Discussion of Papers  
SCHOOL OF ORIENTAL STUDIES, at 5.15—H J Brauholtz The Craft of the African Potter (Lecture)  
UNIVERSITY COLLEGE, LONDON, at 5.30—E A Savage Recent Changes in the Classification of Books in General and Special Libraries (Lecture)  
ROYAL SOCIETY OF ARTS, at 8—Prof E P Stebbing The New Afforestation Work in the Central Plateau of France

### THURSDAY, MARCH 10

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 A.M.—Reading and Discussion of Papers

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5—Dr. C E Lakin The Borderlands of Medicine (Lumleian Lectures) (1)  
 ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15—Prof J. B S Haldane Heredity in Man (4)  
 CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 5 30—Prof L Ruzicka The Life and Work of Otto Wallach (Pedler Lecture)

## FRIDAY, MARCH 11

ROYAL ANTHROPOLOGICAL INSTITUTE (Sociological Research Committee), at 4—Miss C H Wedgwood Stages of Economic Development in Melanesia  
 ROYAL SOCIETY OF ARTS, at 4 30—Indian Meeting

## SATURDAY, MARCH 12

ROYAL INSTITUTION OF GREAT BRITAIN, at 3—Lord Rutherford of Nelson Discovery and Properties of the Electron (3)

## Official Publications Received

## BRITISH

Philosophical Transactions of the Royal Society of London Series A, Vol 230, A692 On the Groupings and General Behaviour of Solid Particles under the Influence of Air Vibrations in Tubes By Prof E N da C Andrade Pp 413 445+plates 21-26 (London Harrison and Sons, Ltd)  
 Nigeria Ninth Annual Bulletin of the Agricultural Department, 1st August 1930 Pp 248 5s Third Special Bulletin of the Agricultural Department The Maintenance of Soil Fertility in Southern Nigeria By C J Lewin Pp 43 2s 6d Annual Report on the Agricultural Department for the Year 1930 Pp 14 1s 6d (Lagos OMS Bookshop, London The Crown Agents for the Colonies)

Canada Department of Mines Geological Survey Memoir 165 Studies of Geophysical Methods, 1928 and 1929 (No 2600) Pp vi+227 4s cents Summary Report, 1931, Part A (No 2292) Pp 196A Summary Report, 1930, Part B (No 2289) Pp 103B Summary Report, 1930, Part C (No 2293) Pp 131C (Ottawa F A Acland)  
 Proceedings of the Royal Irish Academy Vol 40, Section B, No 11 Reports from the Limnological Laboratory 2 The Diurnal Migrations of the Crustacea of the Plankton in Lough Derg By R Southern and A C Gardiner Pp 121-159 (Dublin Hodges, Figgis and Co., London Williams and Norgate, Ltd) 1s 6d

Nigeria Identification of Timbers available in the moist Deciduous to Savannah Forests in Lagos Colony, Abeokuta, Ondo and Oyo Provinces Pp 10 (Lagos Government Printer)

Sydney University Reprints Series 1 (Agricultural and Veterinary Science) Vol 1, Nos 18-24 Series 4 and 5 (Engineering and Architecture) Vol 1, Nos 1-3 Series 6 (Geology and Geography) Vol 2, Nos 12-28 Series 8 (Medical Sciences—Clinical) Vol 1, Nos 22-32 Series 9 (Medical Sciences—Non-clinical) Vol 3, Nos 1-19 Series 11 (Physics, Mathematics and Astronomy) Vol 1, Nos 20-25 Series 12 (Social Sciences—Economics, Education, History, Philosophy, Psychology and Anthropology) Vol 1, Nos 20-28 Series 13 (Zoology) Vol 1, Nos 30-41 (Sydney)

Forest Bulletin No 76 List of Plants collected in West Nepal Pp ii+9 (Calcutta Government of India Central Publication Branch) 4 annas, 5d

Publications of the South African Institute for Medical Research No 29 Immunological Studies in Reptiles and their relation to Aspects of Immunity in Higher Animals By Dr E Grassie and A Zoutendyk Pp 377-459 (Johannesburg)

(University of London) County Councils of Kent and Surrey The Journal of the South Eastern Agricultural College, Wye, Kent No 29, January Edited for the College by Dr S Graham Brade Birks Pp 63 (Wye) 2s 6d, residents in Kent and Surrey, 1s 6d

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1411 (Ae 532—T 3020) Effect of Lateral Stabilizers on Take off of a Flying Boat By L P Coombes and R H Read Pp 5+4 plates 4d net No 1412 (Ae 533—T 3092) Theoretical Investigation of the Take off Time of *Singapore II* By W G A Perring Pp 10+4 plates 9d net No 1415 (Ae 538—S and C 396) Moments of Inertia of Aeroplanes By S B Gates Pp 8+5 plates 9d net No 1416 (Ae 537—S and C 401) Effect of Centrifugal Force on the Controls in a Spin By S B Gates Pp 3 3d net No 1428 (T 3154) Discrepancies in Performances of Aircraft of Same Type By W G Jennings Pp 5+2 plates 9d net No 1424 (M 74—T 3044, 2925) Adhesion and Fatigue of Thin Coatings of White Metal deposited on Mild Steel Surfaces By T E Stanton Pp 8+2 plates 6d net No 1380 (Ae 505—T 3044, 2925) Pressure and Force Measurements on Airscrew-Body Combinations By H Bateman and F C Johansen Pp 62+13 plates 3s net No 1402 (Ae 523—T 3155) Growth of Circulation about a Wing and an Apparatus for measuring Fluid Motion By Dr P B Walker Pp 75+41 plates 4s 6d net (London HM Stationery Office)

The National Institute of Agricultural Botany Twelfth Report and Accounts, 1930-31 Pp 24 (Cambridge)

The Journal of the Royal Horticultural Society Edited by F J Chittenden Vol 57, Part 1, January Pp 156+11+xx+46 plates (London) 7s 6d

The National Opportunity a Fresh Call for Service An Address by H R H the Prince of Wales, delivered at the Royal Albert Hall on January 27th, 1932 Pp 10 (London The National Council of Social Service) 6d

Proceedings of the Royal Society Series A, Vol 135, No A826, February 1 Pp 281 (London Harrison and Sons, Ltd) 9s 6d

The Carnegie Trust for the Universities of Scotland Thirtieth Annual Report (for the Year 1930-31) submitted by the Executive Committee to the Trustees on 10th February 1932 Pp iv+87 (Dunfermline)

The Journal of the Institution of Electrical Engineers Edited by F F Rowell Vol 70, No 422, February Pp 189 296+xx (London E and F N Spon, Ltd) 10s 6d

## FOREIGN

U S Department of Commerce Coast and Geodetic Survey Serial No 522 Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory near Honolulu, Hawaii, in 1925 and 1926 By Daniel L Hazard Pp 109 45 cents Serial No 523 Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Maryland, in 1925 and 1926 By Daniel L Hazard Pp 100 45 cents (Washington, D C Government Printing Office)

Proceedings of the United States National Museum Vol 79, Art 33 A New Middle Cambrian Merostome Crustacean By Charles Elmer Resser (No 2899) Pp 4+1 plate Vol 80, Art 11 North American Two Winged Flies of the Genus *Spathimegeia*, with Descriptions of Five New Species By J M Aldrich (No 2911) Pp 10 Vol 80, Art 17 A New Marine Shell of the Genus *Xenophora* from Florida By Paul Bartsch (No 2917) Pp 2+1 plate (Washington, D C Government Printing Office)

U S Department of the Interior Office of Education Bulletin, 1931, No 17 Bibliography on Education of the Negro, comprising Publication from January 1928 to December 1930 Compiled by Ambrose Calver and others Pp iii+34 10 cents Bulletin, 1931, No 20 Biennial Survey of Education in the United States, 1928-1930 Chapter 2 Elementary Education By Bess Goodykoontz, Mary Dabney Davis and Mina M Langvick Pp 62 10 cents Bulletin, 1931, No 20 Biennial Survey of Education in the United States Chapter 3 Secondary Education Pp 23 10 cents (Washington, D C Government Printing Office)

American Institute of Weights and Measures Scientific Papers of the Institute The Dimensional Problem in International Standardisation By Luther D Burlingame Pp 12 (New York City)

Geological Survey of China Palaeontologia Sinica, Series C, Vol 6, Fascicle 4 *Struthio* Remains from China and Mongolia, with Descriptions of *Struthio uimau*, *Struthio anderssoni* and *Struthio mongolicus* Spp nov By Percy Roycroft Lowe, with a Note on Remains of Carnate Birds, by Dorothea M A Bate Pp 47+4 plates (Peiping)

Proceedings of the Imperial Academy Vol 7, No 10, December Pp xxiv+xxviii+369 395 (Tokyo)

University Observatory, Oslo Publication No 2 On the Theory of Oscillating Fluid Globes By S Rosseland Pp 22 (Oslo A W Brøgger, Boktrykkeri A S)

Memoirs of the College of Science, Kyoto Imperial University Series B Vol 6, No 6, Article 7 Contributions ad *Carcinologiae Asiae Orientalis* By Jisaburo Ohwi Pp 239 270 Vol 6, No 6, Article 8 Über die Dorsiventralität der uniaxialen Blätter von *Iris japonica*, Thunb und ihre Beeinflussbarkeit durch die Schwerkraft von Shun ichiro Imamura Pp 271 331+4 plates 21 22 (Tokyo and Kyoto Maruzen Co., Ltd)

Holiday Courses in Europe, 1932 Compiled by the League of Nations' Institute of Intellectual Co-operation Pp 56 (London Oxford University Press, Boston, Mass The World Peace Foundation, Paris Librairie, Leipzig Alfred Loewentz) 1s

Collection des travaux chimiques de Tchécoslovaquie Rédigée et publiée par E Votoček et J Heyrovský Année 4, No 1, Janvier Pp 48 (Prague Regia Societas Scientiarum Bohemica)

Statens Skogsforskningsanstalt Flygbild No 40 Skogsstradens frukt-sättning år 1929 Av L Tirén Pp 19 30 ore Flygbild No 41 Skogsstradens frukt-sättning år 1930 Av L Tirén Pp 19 30 ore Flygbild No 42 Skogsstradens frukt-sättning år 1931 Av L Tirén Pp 19 30 ore Meddelanden, Häfte 26, 1930-31 Pp iv+582 9 00 kr (Stockholm)

The University of Colorado Studies Vol 19, No 1 Abstracts of Theses for Higher Degrees, 1931 Pp 75 (Boulder, Colo) 1 00 dollar

Field Museum of Natural History Department of Anthropology Guide, Part 5 Ethnology of Melanesia, Joseph N Field Hall (Hall A, Ground Floor) By Albert B Lewis Pp 209+64 plates (Chicago) 1 75 dollars

Cornell University Agricultural Experiment Station Bulletin 530 A Study of Phosphatic Limestone as a Mineral Supplement By Chester Tolle and L A Maynard Pp 27+2 plates Memoir 136 Studies on the Fire Blight Organism, *Bacillus amylovorus* By A L Pierstorf Pp 53+3 plates Memoir 137 Some Nitrogen Relationships in Muck Soils By B D Wilson and G R Townshend Pp 14 Memoir 138 The Effect of Pruning Apple Trees at Planting Time By Joseph Oskamp Pp 50 (Ithaca, N Y)

Proceedings of the United States National Museum Vol 80, Art 7 A Second Collection of Birds from the Provinces of Yunnan and Szechuan, China, made for the National Geographic Society by Dr Joseph F Rock By J H Riley (No 2907) Pp 91 (Washington, D C Smithsonian Institution)

Proceedings of the American Academy of Arts and Sciences Vol 66, No 13 Records of Meetings, 1930-1931, Officers and Committees for 1931-1932, List of the Fellows, Associates and Foreign Honorary Members, Statutes and Standing Votes, Rumford Premium, Index Pp 479 565 1 35 dollars Vol 67, No 1 Volume—Temperature—Pressure Relations for several Non volatile Liquids By P W Bridgman Pp 27 60 cents Vol 67, No 2 Physical Properties of Single Crystal Magnesium By P W Bridgman Pp 29 41 40 cents (Boston, Mass)

Ministerio da Educação e Saude Publica Observatorio Nacional do Rio de Janeiro Taboas das Mares para o Ano de 1932 nos Portos do Rio de Janeiro, Belem, S Luiz, Amarração, Camocim, Fortaleza, Natal, Cabedelo, Tambau, Recife, Aricaçu, Baia, Ilhéos, Santos e Parangua Pp 185 (Rio de Janeiro)

Ministerio da Educação e Saude Publica Anuario publicado pelo Observatorio Nacional do Rio de Janeiro para o Ano de 1932 Ano 48 Pp xi+408 (Rio de Janeiro)

Société Française de Physique Annuaire 1931 Pp 111 (Paris Société Française de Physique)



SATURDAY, MARCH 12, 1932

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## National Economy and Fundamental Research \*

THE report which is presented annually to Parliament by the Department of Scientific and Industrial Research is not only a summary of the Department's activities but also an impressive picture of the manifold ways in which scientific research is applied alike to the solution of industrial problems and to the everyday needs of society. It might be expected that, in a year of sustained industrial depression and unemployment, the financial stringency and imperative need for national economy would direct first attention to the details of the work carried out under the Department, in search of justification for the expenditure of the sums of money entrusted to the Department. It is probable, however, that the attention of most readers will be arrested in the first instance not by the summary of work but by the report of the Advisory Council, in which a masterly analysis, over the signature of Lord Rutherford, of the development of the Department and the fundamental relations of industry and scientific research is presented.

It is only when the fundamental principles which determine the influence of industry on science and of science on industry are rightly apprehended that any accurate assessment of the detailed results of the work of the Department is possible. Recent events do not encourage an easy optimism that these principles have yet received adequate recognition in the counsels of either industry or the State. On the contrary, the report of the May Committee on National Expenditure affords uncomfortable evidence that scientific research is still regarded as an expensive luxury.

The Advisory Council has set before itself, as its main endeavour, to encourage industry to look on scientific research not as a last resource but as an essential part in the business of production. While, however, this policy has substantially increased the competitive power of British industry, and while industry is more and more anxious to take advantage of applied science whether through the Department or by other means, the Advisory Council considers that the attitude towards research is still too often one of hope rather than of faith.

The fundamental factor of the situation, that the initial advantages which Great Britain secured through her island position, her natural resources, and the technical skill of her workers, are no

\* Department of Scientific and Industrial Research. Report for the Year 1930-31 (Cmd 3989) Pp iv+186 (London H M Stationery Office, 1931) 3s net

longer sufficient in themselves to enable our manufacturers to withstand the organised and scientific rivalry of competing countries, is now generally recognised

"Scientific Research", declares the Advisory Council, "has in the past made striking contributions to industrial research and it will make them in the future. But the nation which will enjoy the benefits of science in the day-to-day progress of its industries is the nation which habitually applies scientific method and scientific knowledge, and it is that nation which will be able to seize the more spectacular achievements of science in the industrial sphere. Scientific research cannot provide a ready-made solution of any of the present industrial difficulties, but it does point the road along which persevering effort may enable industry to find a way out of some of those difficulties."

This emphasis on the need for scientific method and research in industry is welcome, but the Advisory Council does not advise or recommend unrestricted or greatly increased expenditure on research for the solution of industrial difficulties. The view is taken that the expenditure which is defensible in the national interest depends on the extent to which industry generally is prepared to apply scientific method and advances in scientific knowledge.

This admirable statement of policy has been hailed in some quarters as a justification for restricted expenditure on research, and, significantly enough, by industries the difficulties of which are notoriously due less to economic conditions than to neglect of scientific method and research in the past. Temporary protection of these industries by imposition of a tariff can only be justified as affording them an opportunity of putting their house in order, and should be contingent upon the industry re-orientating its attitude to fundamental research with the object of accumulating a reserve of fundamental knowledge to assist in tiding over bad times and to strengthen the industry to meet independently competition from abroad.

The report from the Advisory Council is, however, emphatically a plea for more widespread education in industry as in public affairs. The full utilisation of the results of scientific research and the substitution of scientific for empirical methods can only be secured as a result of confidence in the scientific workers engaged in the study of the problems concerned and of acquaintance with the existence and value of this large body of scientific knowledge and research. Marked progress in this task of education is indicated in the report, although

the research associations themselves have found it advisable to take definite steps to bring home to their members the practical significance of the scientific conclusions which have been reached. As such educational work succeeds and extends, the Advisory Council will be committed, in the pursuit of its declared policy, to increasing expenditure on industrial research, until the progression from haphazard empirical methods to those of scientific control and direction by the use of instruments of precision in technical practice, which is characteristic of the present industrial revolution, has largely been effected. The national interest clearly demands that only the capacity and willingness of industry to apply the results of such research should limit the State expenditure thereon.

The moderation of this report is, however, equalled by the breadth of its vision, and in an important section which discusses the application of new inventions, the Advisory Council points out that new industries are not in general created by direct scientific discoveries. They can usually be traced to remote origins, and the history of the relations between invention and industrial development promises no short cut to renewed prosperity. As example of this contention the report cites the growth of the radio industry from John Henry, Clerk Maxwell, and Hertz's theories and investigations in the middle of last century. Numerous other examples have frequently been quoted in our columns in discussing the influence of creative science on industry, and recently Dr L. V. Redman, in his address on "Research as a Fixed Charge" on receiving the Grasselli medal of the Society of Chemical Industry, stressed the great length of time that is usually required to bring a piece of promising research into a profitable industry.

It is these facts which lead us to view with misgivings the decision of the Committee of the Privy Council, in curtailing the expenditure of the Department of Scientific and Industrial Research, "to concentrate available funds on the work of the most immediate practical value to industry, leaving to happier times the expansion of work of which the results could only be available at some more distant date." For all that the Committee expresses the belief that the immediate usefulness of the Department to industry will not be seriously impaired by the economies necessitated, the fact cannot be disguised that the concentration recommended is, in fact, robbing the future.

It must be admitted that the Department had a difficult task and one that it could probably only



discharge satisfactorily when the education of industry and public opinion generally as to the value of scientific method and research has become much more advanced than at present. Misgivings about the actual policy adopted are less a criticism of the Department than of the general attitude to scientific research prevalent in Great Britain.

Although scientific methods are much more widely used in almost all our industries than even a few years ago, there is not yet a general disposition to accept an adequate and sustained programme of research as a fixed charge, comparable with insurance, depreciation, obsolescence, etc., without which no industry can progress, if indeed it can survive. Science, whether in its broadest aspect or its narrow technical sense, will not occupy its proper place in industry until the industrialist is prepared not merely to admit its possibilities and accept its occasional assistance but also to incorporate it as part of his industrial practice. Such incorporation involves not merely the support of research work, whether conducted in his own laboratories or outside, or in co-operation with other firms, but also continuous contact with research in matters of interest to his industry, wherever that research is prosecuted. For the pursuit of a policy of this kind, the industrialist must maintain a competent scientific staff of his own, and see that a scientific outlook is represented not only among the subordinate staff but also in high places.

This question of scientific outlook is all-important. Amid the complexities of modern industries, industrial research can easily prove sterile through misdirection; the best results can only be attained under the direction of those in whom familiarity with scientific method and outlook is accompanied by a knowledge of the economic and industrial aspects of processes which the researches may benefit or even create. Intimate contact between manufacturing practice and the work of the laboratory is essential if industrial research is to bear its proper fruit, and the development of industrial and scientific research is a matter of leadership as well as education. This is clearly recognised by the Advisory Council, and not the least important aspect of the Department's work is the assistance given to post-graduate students and others in their training in methods of independent scientific investigation under the general supervision of the Department. This assistance is a direct contribution to the staffing of scientific, technical, and administrative positions in industry with men of the requisite ability, and it is disappointing to find that during the period

1925-30 the number of students in training who proceeded to scientific service in industry or under Government was 141 and 52 respectively, as compared with 181 and 80 in the period 1920-25. The provision of an efficient scientific personnel in industry is all-important alike for the effective direction of research and for its proper assessment as an integral part of industrial policy and development.

There are many more firms than formerly in British industry where a considered research policy and programme is an accepted part of manufacturing practice, and in many others scientific and technical methods of control have replaced the less accurate empirical methods. The evidence does not show, however, that research, and in particular fundamental research, has yet received anything like full recognition from our industries as a whole. Largely this is due to the disparity between the number of administrative posts held by scientifically trained men, whether in industry or in Government service, in Great Britain as compared with other countries. The technical factors involved in modern industry and, indeed, in general administration cannot be accurately appraised apart from technical and scientific knowledge.

While admittedly many of our research workers, particularly those engaged in academic research, might with advantage be more closely acquainted with industrial conditions, there are few scientific workers indeed who imagine that research is a panacea for all industrial ills or more than one essential factor in industrial progress. Industry's difficulties arise much more from its direction by those without the essential technical and scientific training. Under modern industrial conditions, technical and scientific training is a *sine qua non* of competent leadership, and until our industries are much more widely directed by those whose scientific training and outlook render them competent to evaluate research along with other factors involved, it is improbable that industry will display the continuous reliance upon research for its development which it is the aim of the Department to foster. Still less can we expect a satisfactory and authoritative decision regarding the prosecution and endowment of the fundamental and long-range research upon which progress finally depends, until the question is considered in council by experienced industrial leaders and national administrators who count among their qualifications a first-hand experience of scientific technique.

### Engineering History

- (1) *The Story of the Road from the Beginning down to A.D. 1931* By Prof J W Gregory Pp xii + 309 + 16 plates (London Alexander Maclehose and Co, 1931) 12s 6d
- (2) *The Quest for Power from Prehistoric Times to the Present Day* By Hugh P Vowles and Margaret W Vowles Pp xv + 354 + 88 plates (London Chapman and Hall, Ltd, 1931) 15s net

ENGINEERING history not merely tells us of some of man's greatest achievements, but also of necessity carries us back to the beginning of the human race. Primitive men had their tracks and tools, and from these by a long process of evolution have come our great highways with their streams of traffic and our power-houses with their gigantic turbines and water-wheels. Thus in both these fascinating books, one on roads and the other on power, we are taken back to prehistoric times, and then step by step brought down to modern times, with all their marvellous constructions.

Both books are unusually entertaining, both can be read with pleasure either by the expert or the general reader, and both are valuable additions to engineering literature. While, however, Prof Gregory sticks closely to his text and does not trouble us with the tools and appliances the road-makers have used, Mr and Mrs Vowles, in their anxiety to give the reader as much light on the subject as possible, have included chapters on tools, metals, coal, and oil, and even on counting, measuring, and time reckoning. The foretelling of eclipses is undoubtedly of great interest, but we would rather have learnt more of what the authors could tell us of ancient water-wheels and windmills.

It is quite evident that the writing of both these books has been a congenial task to their respective authors. (1) Through his travels abroad, Prof Gregory has had experience of roads in many parts, and the reader will especially enjoy his lively reminiscences and his numerous photographs. The earliest roads, he tells us, were mere hunting trails or game tracks. Roads proper came into existence with the search for materials and for trade, and among the most famous highways of other times were the 'amber' roads of Europe and the 'silk' roads of China. Then, too, there were the 'pituri' roads in Australia, and that astonishing road of the Incas in Peru, four thousand miles long. Paved roads were laid by the Egyptians and Carthaginians, but the Romans were the first to establish a continental system of well-built roads. These matters are all dealt with in the first part of the book.

Interesting as is Prof Gregory's account of the ancient and medieval roads, of far more immediate practical importance is the part devoted to "The Evolution of the Modern Road", with all its facts and figures. Everyone is a user of roads, everyone contributes to their upkeep, everyone grumbles if they fall into disrepair, but soon no one will remember the mud of the roads of thirty or forty years ago. Our roads to-day are costly, it is true, but the saving in discomfort, in shoe leather, in tyres, and in petrol is enormous. But whether it is the teacher intending to give a lesson on roads, a motorist wishing to know how roads are made and kept in order, or whether it is one of the thousands of local councillors in the country desirous to know something of road legislation or road finance, Prof Gregory's book meets their case.

(2) The history of power is a far more complex subject than the history of roads, and calls for an intimate knowledge of up-to-date practice, a vast amount of research, and ability to marshal facts and present them in proper sequence. The success with which Mr and Mrs Vowles have carried out their task is a tribute to the amount of thought and labour they have expended upon it. The book is an admirable result of the combined work of an engineer and a historian. We greatly regret, however, to notice that Mrs Vowles died on March 4, and thus a most valuable combination has come to an end.

The scope of the book is best seen from an enumeration of its various divisions. In the first place, the whole matter is divided into three 'books'. These books contain eight, seven, and four chapters respectively. In the first book the reader makes the acquaintance of man as a tool maker, he is given a sketch of the rise of craftsmanship and of the first control of water, there are accounts of the early structural achievements, such as the pyramids, and of the dawn of transport, and to these are added chapters on the transition to iron, on early measuring, and on engineering in Græco-Roman antiquity.

In the second book the stories of the steam engine and of the steam and hydraulic turbines are told. We meet again with Newcomen, Watt, Perkins, Porter, Edison, Parsons, De Laval, Curtis, Otto, Diesel, Akroyd Stuart, Fourneyron, Francis, and others whose names are familiar to all power engineers, and are given some interesting descriptions of modern power plants. Then in the third book come chapters on the materials of power—coal, oil, alcohol, iron, steel, and other metals—their produc-

tion and properties, and the book ends with an epilogue on "World Power and the Future"

Many of the men mentioned in the book, we fear, will mean little to others than engineers, but the work does not aim at being a biographical dictionary. Like "The Story of the Road", "The Quest for Power" has that most useful feature, a good index

### Plato and the Modern Age

*After Two Thousand Years a Dialogue between Plato and a Modern Young Man* By G. Lowes Dickinson. Pp. 213. (London: George Allen and Unwin, Ltd., 1930) 6s. net

TO what extent have the greatest thinkers of the world guided or in any way controlled its destiny, and are they likely to be more enlightened and inspired and successful now or in the future than they have been in the past? The answer will doubtless vary according to our knowledge and interpretation of history. According to Carlyle, the history of the world centres around its great men, by whom he meant primarily its great thinkers, but though these great ones in the past have undoubtedly played a leading part, as it seems to us, in shaping the course of events, it has been fairly generally acknowledged, at least by the leaders of nearly every religion, that there has been an overruling Power known under various designations, among which Fate or Destiny were the most generally recognised by the ancients. Be this as it may, and reverting to that part of our question which asks whether modern or future thinkers will be more effective, it must be admitted that the quality of modern thought, as compared with ancient, is not infrequently called in question and even deplored as greatly inferior to that of the ancients. Various reasons are assigned for this, but it may at least be urged in extenuation that existence to-day is far more complex and presents much more difficult problems to the thinker than in the olden days.

The extraordinary increase in scientific knowledge has vastly extended the realm of thought and revealed heights and depths which almost make the mind reel in contemplation of the physical universe. In the political and social spheres, largely owing to scientific discovery and invention, the most profound changes have taken place, infinite complexities have been introduced, touching among other things national and international relations, so that here too the thinker can quite easily find himself nearly if not quite out of his depth. Thus we can readily see that the fields

of thought are now infinitely vast and infinitely complex, and turning to the thinker himself we find that he, for his part, has to spend so much time merely in the acquisition of knowledge, of which a certain minimum is essential, that he has little real leisure for serious meditation on the majestic but increasingly mysterious panorama of life which now unfolds before him.

It was therefore a happy thought of Mr. Lowes Dickinson to call up Plato and see how that mighty intellect would react when confronted with the problems of modern existence. The work takes the form of a conversation between the beloved master and a very modern young man, and we can say at once that it has been exceedingly well done, as was only to be expected from such a first-grade classical scholar as the author is universally acknowledged to be. The book is highly stimulative, in some parts helpful and suggestive, and occasionally provocative, thus conforming with most of the demands an eager and inquiring mind can make on any book.

If no very serious contribution is made to the solution of modern problems, it must be remembered that even a Plato, suddenly awakened after two thousand years and confronted with such a marvellously changed world, could scarcely be expected to produce, at short notice and after an hour or two's talk with a modern young man, reasoned solutions to present-day enigmas. But in the course of the talk he is often brilliantly suggestive, and at the finish he rises to transcendental heights and seems to show, though somewhat vaguely, a path upwards in which the human mind may walk with hope and faith that good will ultimately prevail, and some is even now glimmering down from a higher world to which men must strive to attain.

The subjects dealt with in the early stages of the discourse relate to property, forms of government, socialism, population control, war, and education. These comprise Part I. In the second part we have a supremely interesting discussion touching the subordination of the individual by the State in such a way that nobody was, in fact, pursuing any real good. The possibility is considered of enabling the mass of the citizens to attain a real good rather than that this privilege should be limited to a favoured few, but this is ultimately discarded as impracticable, and we next have a description of those things which may be regarded as real goods in themselves, as distinguished from means to other goods. In the final analysis real good consists in truth, art, love. The book ends

with the Platonic doctrine of immortality and of another life deeper and more significant, from which even now some light occasionally shines down

It would seem that, despite the profound and far-reaching changes in the modern world as compared with the ancient, the essential mysteries of existence are very much the same to the modern as to the ancient philosopher. We may have advanced tremendously in physical knowledge, in social organisation, and in industrial efficiency, but despite all this we are no nearer to any adequate explanation of those baffling mysteries which have always loomed up as an impenetrable curtain of the blackest darkness before the human mind.

Those of us who still cling tenaciously, though only as it were by a thread, to some remnant of religious faith, who endeavour to discern a gleam of light in that darkness, and try our hardest to believe, with Plato, that there is a good and that it will ultimately prevail, have yet to acknowledge the harsh realities of existence, and carry on with as much faith and courage and dauntless cheer as we can summon or invoke to our aid. Mr Lowes Dickinson seems to conclude on the right note, and the lofty faith of Plato prevails over the mournful scepticism of the modern young man.

W G LINN CASS

### South African Grasses

*An Introduction to the Study of the South African Grasses with Notes on their Structure, Distribution, Cultivation, etc.* By Dr E P Phillips (South African Agricultural Series, Vol 6) Pp 224 + 121 plates (Johannesburg Central News Agency, Ltd, 1931) 25s net

IT is perhaps not a mere coincidence that the two most recent works of any size on the Gramineæ have come from South Africa. In 1929, Prof Bews issued his book, "The World's Grasses", and now Dr Phillips has written on the grasses of South Africa. The study of the Gramineæ in a country where vast stretches of veld are devoted entirely to the raising of stock is of more than mere academic interest. We in Britain, who are accustomed to the lush meadows of our own land, where the cultivation of grasses presents no real difficulty, often fail to realise the troubles confronting the South African agriculturist, who has to contend with the dual effect of a poor, often alkaline soil and a low atmospheric humidity. It is not surprising, therefore, that a great deal of experimental work is being carried out by the agricultural institutions of

South Africa upon problems connected with grass-lands.

Dr Phillips has endeavoured to produce a general survey of South African grasses. In the introduction, exception is taken to Dr Stapf's use of the term 'floret', which was merely a convenient expression to include with the flower the associated bract and bracteole. All agrostologists, however, will not agree with Dr Phillips's contention that "the descriptions could be simplified, made more definite and understandable if the use of this term is discontinued."

Commencing with a survey of the principal publications dealing with the South African grasses, Dr Phillips strikes an original note in Chap. II. with a detailed list of authors and complete references to genera published by them, with the 'type' or 'standard' species of every genus. Such a comprehensive list has probably never before been compiled and should prove of great usefulness to all interested in the taxonomy of grasses.

The following chapter deals with migration and the distribution of grasses, in which the author, on the assumption that the temperate genera are more primitive than the tropical, and that South Africa enjoyed at one time a cooler climate than at present, suggests three main lines of migration: first, the migration northwards of the temperate grasses along the mountain ranges, secondly, a movement southwards of tropical genera along the valleys, and lastly, a westward migration of tropical grasses into the north-western area and the Karroo.

The questions of veld-burning, grazing, and cultivation are dealt with in another chapter, and stress is laid on the disastrous effects of overstocking, particularly of important watersheds, where the whole aspect of an area may be changed in a few years. A useful list of common names of South African grasses is also given—though, as is usual with 'common' names, the same name is frequently given to widely different plants.

A little more than half the book is devoted to the systematic side of the subject. There are keys to the grass tribes and to the genera, and a description and figure of almost every genus. For some reason, Dr Phillips has preferred to adopt Hackel's arrangement of the tribes of 1890, rather than the more modern systems of Stapf and others. This has meant the retention of the Tristegineæ, an unnatural group which has been dropped by later workers and which did not even figure in the "Flora Capensis." Hackel's Zoysieæ also is placed in the Panicoideæ, whereas all recent authors

place the Zoysieæ in the Pooideæ. At the same time, the Oryzeæ appear in the Panicoideæ, although they occupy a more natural place in the Pooideæ. There appears to have been no justification for resuscitating Hackel's system at this stage, the more so since the other works on the Gramineæ available to the South African student, such as the "Flora Capensis", "Flora of Tropical Africa", and Bews' "The World's Grasses", adopt more natural arrangements.

The key to the genera is of the dichotomous variety. It covers 29 pages and appears to work reasonably well. The descriptions of the genera are in most cases very complete, and the distribution and altitudinal range of each genus is given in almost every instance. The illustrations, however, which are line drawings—and might, quite well, have contributed greatly to the value of the book—are very poor and reflect little credit on the artist responsible. Quite a useful feature in most of the illustrations is a cross-section of the leaf—often a useful character in confirming a determination.

The book is a volume of an agricultural series, and lacks a little in quality of paper and of binding. The high price is due, no doubt, to the large number of illustrations and to the restricted circulation such a work must inevitably enjoy. The book must obviously find a place on the bookshelves of all who study South African grasslands. F B

### Short Reviews

*The Bushman*. By E J Dunn. Pp xii + 130 + 34 plates. (London: Charles Griffin and Co., Ltd., 1931.) 15s net.

THE author of this book tells us that his information was obtained by personal observation some fifty to sixty years ago while doing government geological work, chiefly in the districts bordering the Orange River. As a record of personal investigation among a people now practically exterminated, the work is of considerable value. Moreover, the writer is a geologist, and is therefore used to descriptive work and the careful noting of details.

It must be admitted, however, that the work is of unequal value. The latest books on the pre-history of South Africa, which in the nature of the case include studies of early Bushman cultures, do not seem to have been consulted. There is a large number of plates depicting stone implements, most of which would to-day be classed as belonging to the Smithfield culture, nothing is said of Wilton varieties. Admittedly, what would now be called Fauresmith types are shown as pre-Bushman on Plate xxxii, and those of the Still Bay culture on Plate xxxiii, though nothing is said about the older, Stellenbosch, implements, and no attempt is made to classify the various industries.

Similar comments apply to the art. Actually, the Bushman paintings and engravings vary in different geographical areas. For example, the engravings seem to centre around Kimberley, whereas the finest paintings are found in the mountains to the east, another series of paintings totally differing in style can be seen in the extreme south and south-east of the Union. Mention of superpositions of paintings, giving a chronological sequence, is made but not followed up. As a matter of fact, results of recent work on the superpositions of styles over large areas seem to suggest that most of the art in Southern Rhodesia is much earlier than that of the Union, and that it is these Rhodesian paintings which so resemble those of late Palæolithic age in eastern Spain. Incidentally, too, the African paintings are not really like those of the French and North Spanish group, such as can be seen at Altamira, with which the author compares them.

Yet after this somewhat drastic criticism, I should like to say again that records of first-hand observations of Bushmen, made at a time when they still flourished, are not easy to obtain to-day, and the memories of an observer with a scientific mind are therefore very valuable. M C B

*Publications of the Wagner Free Institute of Science*  
Vol 2 *Studies of Evolution in the Genus Spirifer*  
By C L Fenton. Pp x + 436 (50 plates). (Philadelphia: Wagner Free Institute of Science, 1931.) 6 dollars net.

THE work of a palæontologist who applies experimental biological principles to his results, and by their aid formulates a theory of evolution, is bound to be of general interest. The author has studied the evolution of three genera of spirifers, *Sp. varians*, *Sp. obliquistratus*, and *Sp. hungerfordi*, in minute detail, and finds that none of the existing theories of evolution will account for the apparent orthogenetic tendencies of characters such as ornament, which cannot be of selective value. Natural selection, heterogenesis, Buffonism, Lamarckism, Eimer's theory of orthogenesis, and Guyer's serologic orthogenesis are all found to be insufficient or unsatisfactory.

The theory of racial life cycles is made the basis for a new theory of phyletic senescence through decreasing metabolism. Child has found that the metabolic rate is high in a young cell or organism, and that there is a general decline throughout normal life. Mr Fenton applies this principle to the racial cycle as well as to the life cycle, and states that racial senescence is due to a similar falling off in the metabolic rate. Evidence of such racial senescence is shown by a "general progressive increase in susceptibility to injury and other disturbance, and a decrease in the capacity for repair". The whole hypothesis is based on a physiologicoheredity—that is, variations initiated physiologically are impressed on the germ plasm.

In proposing a theory which requires so close a connexion between ontogeny and phylogeny, the author states he finds that ontogeny recapitulates phylogeny in general in the spirifers, but the ontogenetic record of phylogeny may be distorted by

tachygenesis and lipopalingenesis. The Biogenetic Law is generally supported by palaeontologists. This, he explains, is because in animals with shells, such as brachiopods and molluscs, the early stages form a permanent and not a temporary basis for new characters as in insects or vertebrates, usually selected by those who criticise the Biogenetic Law. Thus new characters arise by additions to the life cycles and not by modifications of pre-existing characters.

*Пегматиты их научное и практическое значение*  
Tom 1 *гранитные пегматиты. (Pegmatite Eigenschaften, Geochemie, Verbreitung, Verwendung Band 1 Granitpegmatite)* By A. E. Fersmann. Pp. 646. (Leningrad Akademie Nauk SSSR, 1931.) 20 rub.

THE author has devoted more than twenty years to the study of pegmatite, personally explored many of the pegmatite areas in Russia and abroad, and initiated organised investigations of the problem in Russia centred in the Mineralogical Museum of the Russian Academy of Sciences. The book sets down, in a monographic form, the main results of theses and studies, and reviews critically the work of other authors. In the first part (Chapters 1-x) a general discussion of the chemical, physical, morphological, and geological characters of pegmatites is presented, and the methods of investigations are described. The second part (Chapters xi-xviii) contains a monographic description of various pegmatites and their classification. The following chapters (xix-xxv) constitute the third part, containing a discussion on the mineralogy of pegmatites and on the geochemical and metamorphic phenomena connected with their origin. A bibliography of the main literature on pegmatites and a list of pegmatite areas of Russia are appended, while a special appendix is devoted to the economically important pegmatites. A second volume, dealing specially with the pegmatites of the basic, sienitic, and nephelin-sienitic magmas, is in the course of preparation.

*The Reclamation of Land from the Sea*. By F. M. Du-Plat-Taylor. Pp. xv+153. (London: Constable and Co., Ltd., 1931.) 21s net.

LAND reclamation and coast erosion are matters which very closely concern the inhabitants of sea-bordered countries. The Dutch have for centuries waged an unremitting contest with the sea, driving it back inch by inch, in order to provide themselves with space to live and expand. Not less vital in Great Britain to the dwellers of East Anglia and Yorkshire is the gradual but constant encroachment of the sea on their clay cliffs and erodible soils, and though, as Sir George Courthope points out in his introductory note, "England has gained from the sea more than she has lost", the local losses are not always, or necessarily, compensated by the gains elsewhere.

Major Du-Plat-Taylor's book commences with an exposition of the objects and methods of reclamation, and proceeds to consider in detail systems of reclamation by enclosure, with a special

account of the project for the reclamation of the Zuyder Zee (to which two chapters are allocated). Reclamation by filling and by simple drainage are also considered. There are chapters on the auxiliary works and plant required for the various operations of reclamation and drainage work, embodying a good deal of useful information, a certain amount of which has been derived from the author's personal experience. Altogether, the book will be of undoubted utility to practising engineers, as assembling a quantity of data and information for reference in a compact and accessible form. There are numerous illustrations, both views of works and diagrams. B. C.

*Jahrbuch des Forschungs-Instituts der Allgemeinen Elektrizitäts-Gesellschaft* Band 2, 1930. Pp. 332. (Berlin: Julius Springer, 1931.) n.p.

THE second annual volume of the Research Institute of the Allgemeine Elektrizitäts-Gesellschaft maintains the high standard of scientific and technical achievement reached in the first volume. It is beautifully printed on art paper, and so the photographs are excellently reproduced. All the economic and technical papers given have previously appeared in various trade journals, but the scientific worker will find most of them of great interest. Advanced mathematical theorems are given fairly fully, so that it is not difficult to verify them, and the mathematical symbols are clearly printed. The papers are collected into groups under definite headings, for example, acoustics, electro-optics, electron physics, atomic physics, atomic chemistry, electric heating, etc. The various sections are connected by prefatory reviews giving a résumé of the present state of the research field.

Scientific workers will be interested in the 'demonstration research' into Störmer's polar light theory by E. Brüche and W. Ende, and in the paper on "Theoretical and Experimental Results on the Aurora Polaris", by E. Brüche. The latter paper is printed in English. To illustrate the thoroughness with which the technical researches are carried out, we find in a paper on electric cooking the specific heats of many articles of diet. The specific heat of milk is given as 0.90, oysters 0.84, eggs 0.76, veal 0.70, fresh fish 0.80, fruit 0.81, game 0.80, pork 0.55, pork fat 0.50, blood 0.93, and so on.

*The American Annual of Photography, 1932*. Vol. 46. Edited by Frank R. Fraprie. Pp. 294 + Ads. 46. (Boston, Mass.: American Photographic Publishing Co., London: Sands, Hunter and Co., Ltd., 1932.) Paper, 10s.; cloth, 15s.

THIS photographic annual is exceptionally well produced. It contains many examples of modern work. The book is mainly devoted to articles on photographic topics, a few of these are technical, but for the most part they deal with the artistic side of the subject. A few pages at the end of the book are devoted to a "Formulary" in which are brought together a great many formulæ for developers and such like necessities. S. O. R.



## The British Polar Year Expedition, 1932-33

ON the ground that the relatively meagre scientific results from previous polar expeditions were due to their sporadic occurrence, Lieut Weyprecht, of Austria, proposed in 1875 that an effort should be made to organise a number of simultaneous expeditions which would co-operate on a uniform plan over a full year. The result was the organisation of what has come to be called the First International Polar Year, 1882-83, when fourteen expeditions were sent out by twelve different countries, twelve to high northern latitudes and two to the Antarctic. Great Britain collaborated with Canada in establishing a station at Fort Rae, on the north arm of the Great Slave Lake. All the stations were fully equipped with such instruments as were then available for comprehensive meteorological and magnetic observations, they worked on a common pre-arranged plan. Judged from the practical results and the large number of researches that have been based on the data collected during that First Polar Year, the venture was entirely successful.

Since 1882, progress in meteorology, terrestrial magnetism, and allied lines of investigation has developed apace, and many problems dependent for their solution on a repetition of just such a co-operative network of stations as set up in the First Polar Year, but using improved and more refined methods of recording and observation, have presented themselves. It was felt that there could be no more fitting celebration of the jubilee of the first international year than by repeating it, and in 1929, on a proposal of Admiral Dominik of the Deutsche Seewarte, the International Meteorological Conference undertook to organise a Second Polar Year. The International Union of Geodesy and Geophysics, at its meeting at Stockholm in the same year, endorsed the proposal and promised financial aid. An International Commission for the Polar Year, 1932-33, was set up, with Dr la Cour of the Danish Meteorological Service, as president. National committees were appointed in each country to organise the several contributions in these countries in collaboration with the International Commission.

In Britain the National Polar Year Committee, with Sir Henry Lyons as chairman, represents the interests of the Royal Societies of London and Edinburgh, as well as most of the other societies and institutions interested in such work. The Government, through the Meteorological Office, Air Ministry, has promised a grant-in-aid not exceeding £10,000 to the Polar Year efforts in Great Britain, and this has been supplemented by many generous donations in instrumental and food equipment by British manufacturers and wholesale firms.

Because it was strongly recommended by the International Commission that, so far as possible, the original Polar Year stations should be re-occupied, the British National Committee decided to send a party to the Fort Rae site on the Great Slave Lake. [Canada this year will organise her

own Polar Year programme: the main station will be established at Chesterfield Inlet, with probably a second at Copper Mine for photographic auroral work.] The reopening of the mountain observatory on Ben Nevis was also considered, but questions of cost and doubts as to the real value to be obtained from only a year's further observations led to that part of the programme being dropped. Efforts were to be concentrated in equipping very fully the Canadian station at Fort Rae, and to reinforcing the observational facilities at key stations in the British Isles for meteorological and auroral work. At a later stage it was decided that advantage should be taken of opportunities for getting a complete survey of the variations in the magnetic field at high latitudes, and also auroral observations and photographs from the same stations, to establish a station for measurements of the ionisation content and its variations in the conducting regions of the upper atmosphere. It has now been decided that Prof E V Appleton will take a fully equipped party to Tromsø this summer for such work, and the party will continue to observe throughout most of the Polar Year period.

The programme of observational activities drawn up by the International Polar Year Commission is concerned almost wholly with meteorology, terrestrial magnetism, aurora, and, to a less extent, atmospheric electricity. In each of these subjects the equipment of the British party to Fort Rae will be complete. In addition to maintaining continuous records of all the meteorological elements by autographic instruments, much attention will be given to the investigation of the conditions in the lower levels of the atmosphere by observational and instrumental methods. Frequent pilot balloon ascents will give an insight into the circulation over that part of north-west Canada, and special efforts will be directed to penetrating the stratosphere by sounding balloons on certain days each month previously selected by the International Commission. To obtain the most useful information about the temperature conditions up to and, if possible, well beyond the tropopause will necessitate the sounding balloon with its attached self-recording meteorograph ascending to 12 km at least. The recovery of the instrument bearing the record after the apparatus has fallen in the difficult country around the Lake is one of the problems connected with the expedition not yet solved.

For the work in terrestrial magnetism the expedition will be equipped with alternative sets of absolute instruments, a Smith portable magnetometer and earth inductor representing the modern methods, and a Kew unifilar magnetometer and a dip circle representing the older technique. For the continuously recording instruments the intention is to take three complete sets of magnetographs, each independently capable of recording by photographic means the variations in the three components of the earth's field. Of these, two sets have been specially designed for high latitude

work by Dr. la Cour, Copenhagen, and will supply the standard and special quick-run traces respectively. By running a third set of variometers at low sensitivity it is hoped to ensure that even in the biggest perturbations of the field during magnetic disturbance no trace will be lost. The provision of a double set of absolute instruments is intended not to cater for emergencies alone, the present Fort Rae, which will be the main base of the expedition, is some seventeen miles farther up the north arm of the Great Slave Lake than the settlement of fifty years ago. For such purposes as establishing the secular change in the magnetic elements it will therefore be necessary to carry out sets of parallel observations at this subsidiary station.

The necessity for occasional occupation of the old Fort Rae site will be turned to further useful account by equipping the sledge party which will travel there in the winter months with a spare auroral camera, and by having some means of communication between the two bases. In this way it is hoped to use the two posts as base line stations for photography of aurora, and so to provide data for determining its height by the well-known methods developed by Prof Stormer. It is of interest to observe in this connexion that, so far as is known, Fort Rae is very near to the zone of maximum frequency of aurora.

These three fields of meteorology, terrestrial magnetism, and aurora constitute the primary work of all the Polar Year stations, but, in addition, the party at Fort Rae hopes to obtain very complete information regarding the atmospheric electrical

and allied phenomena of the region. Using a Bennet electrograph, continuous records of the potential gradient of the earth's electric field will be kept, and equipment will be taken to observe, whenever opportunity allows, the conductivity of the air and the air-earth current using a modified Wilson electrometer, the small ion content of the air using a modified Ebert apparatus, the nucleus content with the standard Aitken instrument, and, if possible, the rate of production of atmospheric ionisation with an apparatus specially designed at Kew Observatory.

The Fort Rae party will consist of six men under the leadership of Mr J M Stagg of the Meteorological Office. They will leave England about the middle of May of this year and proceed via Montreal to Edmonton. North of Edmonton the route will lie down the River Athabasca to the lake of that name, and then down the Slave River, past the seventeen miles of rapids between Fitzgerald and Fort Smith, to Fort Resolution on the south side of the Great Slave Lake, thence across the body of the lake and up the north arm nearly to its most northern extremity. This should be reached by the third week in June, thus giving time to erect the special non-magnetic huts required for the absolute observations and continuous registration of the magnetic field and instal the instrumental equipment in readiness for the official starting date of the Second Polar Year on Aug 1. The party will continue observing until as late in August 1933 as may be safely done without undue risk of being frozen in for the next winter.

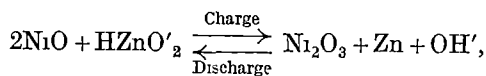
### The Drumm Traction Battery

By Prof A J ALLMAND, F R S

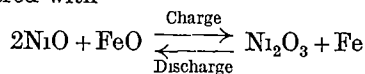
WIDE interest has recently been aroused by reports of the successful trials of an electric tram propelled by a Drumm transport battery, as also by certain details concerning the battery itself which have been made public. During the last two years I have had ample opportunity of examining and experimenting with the Drumm cell at various stages of its evolution, and it seems desirable now to put on record a statement of its main electrochemical features.

It is an alkaline cell, and the only metals which enter into its construction are stainless steel, pure nickel, and, at present, nickelled steel. Its mechanical strength and so forth are correspondingly satisfactory. As in other successful alkaline batteries, the positive plate system consists of the  $\text{Ni}(\text{OH})_2$  -  $\text{Ni}(\text{OH})_3$  mixture first developed by Edison, several types of such positives have been employed. Whereas, however, in other cells, the negative plate system is essentially  $\text{Fe}$  -  $\text{Fe}(\text{OH})_2$ , it consists of  $\text{Zn}$  -  $\text{Zn}(\text{OH})_2$  in the Drumm battery. Moreover,  $\text{Zn}(\text{OH})_2$  is soluble in alkali, whilst  $\text{Fe}(\text{OH})_2$  is not. Consequently, instead of containing a solid hydroxide which becomes reduced to metal on charge, the Drumm negatives consist of nickel gauze grids, immersed in the solution of zinc oxide in potash

constituting the electrolyte, and these on charge become coated with metallic zinc. The cell reactions in this 'zinc' accumulator, written in their simplest form, are consequently



as compared with



in the 'iron' accumulator.

One feature of such a cell will be immediately obvious. Owing to the relative positions of zinc and of iron in the electrochemical series, its voltage will be unusually high for an alkaline cell. Depending somewhat on the part of the positive discharge curve used in practice, the average figure under normal conditions for the fully charged cell is about 1.86 volts, as compared with about 1.34 volts for the iron accumulator. The forty per cent increase represents a considerable advance. This is important, but the main advantage claimed by the inventor, which would seem to put the cell in a class of its own amongst transport batteries, depends on facts of quite a different nature.

Briefly, whilst the two electrode processes  $\text{Fe} + 2\text{H}^+ \rightleftharpoons \text{Fe} + \text{H}_2$  are subject to considerable irreversible effects, which limit the maximum practicable current densities to relatively low figures, this is not the case with the electrode processes  $\text{Zn} + 2\text{H}^+ \rightleftharpoons \text{Zn} + \text{H}_2$ . There is no need to emphasise a point known to all. Iron is a metal which becomes passive with notorious ease when used as anode, and the work of Foerster has demonstrated the existence of important retardation effects during its cathodic deposition. Zinc, on the other hand, dissolves freely on anodic polarisation, as in many types of primary cell, and very high current densities are known to be used successfully in its technical electro-deposition. As a result, far heavier currents can be put through a Zn/Zn than through a Fe/Fe electrode, during both charge and discharge. The properties of the  $\text{NiO}/\text{Ni}_2\text{O}_3$  electrode are sufficiently good from the same point of view with the consequence that the Drumm battery, which combines these two electrode systems, can both be charged and discharged at abnormally high rates. The standard rate of charging of a single technical cell of total weight 112 lb, allowing for all losses in efficiency, corresponds to an input of 0.134 effective watt-hour/lb/minute, about four times the rate normal to other alkaline batteries. In practice, the same cell is normally discharged at a current of 400 amperes and an average voltage of 1.65 volts, equivalent to practically 0.1 watt-hour/lb/minute. This itself is twice the highest discharge rate recommended for other alkaline batteries. But, over and above this, the current can, when required, be raised to 1000 amperes for limited periods, corresponding to an energy delivery of about 0.22 watt-hour/lb/minute—a very high figure indeed. The cell deals with these heavy loads quite comfortably, with no sign of deterioration.

The power of furnishing energy at these unprecedented rates makes it possible for a traction battery of Drumm cells to overcome the grave disadvantage inherent in the majority of such batteries, namely, the impossibility of furnishing rapid accelerations. The train now operating between Dublin and Bray can accelerate from a standstill at about 1 mile per hour per second, attain speeds of 40-50 miles an hour with ease, and is provided with a successful system of regenerative braking, whereby an important fraction of the energy surge made available on a down-gradient or on decelerating at a station is returned to the battery.

There is one further very important matter. The

specific watt-hour capacity of the Drumm cell on a single charge is not particularly high. In fact, in the case of the battery especially designed for the above train, it is very low—perhaps 15 per cent of that of an iron battery. But its capacity for high loads enables this battery to be charged at the terminus and afterwards discharged many times during the working day, probably twenty such charges will be standard when in full operation. Consequently, the daily work of which unit weight of battery is capable will be, not 15 per cent, but 300 per cent of the normal—a fact naturally of prime importance when considering initial costs, quite apart from the elimination of the expense of an all-night charge.

With regard to other practical points, the cell possesses to a high degree the virtues of simplicity of construction and of operation, whilst there are definite grounds, which I am not at liberty to mention, for anticipating a long life. Neither overcharge, nor overdischarge, nor long idle periods have any ill effect of importance. Self-discharge is exceedingly low.

A few electro-chemical details may be added in conclusion. Under standard working conditions, the average current efficiency is 92-93 per cent, the concordant result of long-continued tests on cells of varying capacity. The average voltage during charge and discharge is 2.03 and 1.65 respectively. The energy efficiency is therefore practically 75 per cent. These are favourable figures, and strikingly so when it is remembered for what high loads they hold good, they also connote relatively small gassing and low temperature rise. During the greater part of both charge and discharge periods, the polarisation alters linearly with time. Investigation shows this change to be due almost entirely to the positive plate. The polarisation at the negative is considerably less than at the positive, and scarcely alters with time (unless the cell be overdischarged). Of the total voltage losses in a cycle, roughly half is associated with the positive, and one-quarter each with the negative and the electrolyte. The exact concentrations of caustic potash and of zinc oxide in the latter vary in accordance with the purpose for which the cell is designed, and there is no point in giving detailed figures. The essential points are, of course, an electrolyte of high conductivity and sufficient dissolved zinc oxide for the operating conditions.

It is clear that Dr. Drumm has produced a cell of somewhat remarkable properties, and that, although primarily designed for transport purposes, these properties may lead to its utilisation in other fields.

### Adsorption of Gases

THE recent discussion held by the Faraday Society at Oxford, on Jan 12-13, was devoted to a consideration of the problems connected with the adsorption of gases. The general introduction was given by Prof. H. S. Taylor of Princeton University, and a number of distinguished foreign guests presented their communications in person, including Prof. A. Magnus of Frankfurt, Prof. A. F. Benton of Virginia, Prof. E. Huckel of

Stuttgart, Dr. A. Farkas of Frankfurt, and Drs. H. Dohse and Schuster of Ludwigshafen. The attention of the meeting was devoted almost exclusively to two important considerations, types of adsorption and discontinuities in adsorption processes.

A study of the chemical behaviour of adsorbed molecules as well as the great difference in the heats of adsorption of gases on substances such as silica

and the metals led to an early differentiation between two types of adsorption, one where the adsorbate was relatively lightly attached, with small heats of adsorption, and another type where the heats of adsorption approximate to those involved in chemical linkages. These were early characterised as physical and chemical adsorption respectively. If this is in fact the case, it should be possible to demonstrate the actual existence of these two types of adsorption in the same system, for the physical type which is only loosely held should be operative alone at low temperatures, whilst the other type should occur at higher temperatures, if as in chemical reactions an energy of activation is required. Examples of such dual adsorption processes in the same system were first demonstrated by Benton and later by Nikitin, more recently their number has been extended very considerably by Taylor, by Garner, and by Kingman.

Following the earlier concepts, it has been customary to consider the low temperature adsorption as due to Van der Waals forces, and the one occurring at higher temperatures and requiring an energy of activation as due to chemical forces, that is, due to a change in the character of the union of the metal to adsorbate. An analysis of the problem by Lennard-Jones indicates that this is not necessarily the case, for a diatomic molecule may be regarded as dissociated on activation into atoms on the metal surface, and it is shown that the potential curves for the approach of a molecule and of an atom may cut one another, so that the transition from one form to the other is possible. In the non-activated adsorption we are dealing with the system  $M + X_2$ , in the activated adsorption with  $M + 2X$ , the nature of the forces involved in both cases are, however, identical. It is clearly possible that, in addition to non-activated and activated adsorption, chemi-adsorption involving a more fundamental electronic change may occur, for example,  $M + X \rightarrow M^+X^-$ , requiring again a different energy of activation. Examples of all three types of adsorption are known, and the evidence for the presence of these three types in one system over a suitably wide range of temperature has been presented by Garner.

Activated adsorption probably cannot involve in all cases the actual separation of the atoms in a diatomic molecule into two independent entities, for example, carbon monoxide on metals, nor can the energies of activated adsorption and of chemi-adsorption be always widely different from one another, for it appears probable that oxygen on most metals, and nitrogen on many metals, undergoes chemi-adsorption as readily as or more readily than activated adsorption. It is interesting to note that the activated adsorption of carbon dioxide on iron probably involves the formation of carbon monoxide, which is 'physically' adsorbed, and chemi-adsorbed oxygen. It is also worthy of comment that the linkage of the metal atom holding the adsorbate is weakened by the process of chemi-adsorption, and in many cases on re-evaporation the substrate is removed in true chemical combination with the adsorbate.

The nature of the process of activation is as yet not so clearly visualised. Adopting for energies of activation values less than 15,000 calories per gm. molecule, activation cannot result on mere collision of a gas molecule with any portion of the metal surface, since the velocity of the process at low temperatures is too small. Certain portions of the surface appear more susceptible than others. The investigations of London and of Polanyi make it appear probable that the energy of activation is dependent on the lattice spacing or the distance between two metallic atoms in the adsorbent. The energy required for activation rises rapidly as a certain optimum spacing is departed from either on contraction or expansion.

Over certain ranges of temperature the rate of uptake of gas in the activated adsorbed state is slow. No unanimity of opinion was obtained at Oxford as to the cause of this slow rate of uptake. It is believed by some that this actually represents the rate of activation, and energies of activation have been calculated from the velocities at different temperatures. That the process of surface migration and intergranular diffusion along the secondary structure of the metal crystal on solid surfaces requires an energy of activation for the adsorbate to jump over the potential barriers between the atoms has been experimentally demonstrated in a number of cases, and formed the subject of several communications, including those of Becker for alkali metals, Volmer for mercury and benzophenone, Charlton, Semenov and Shalnikov for metals, Ward for activated adsorbed hydrogen on copper, and by the writer for gases. As pointed out by Lennard-Jones and by Fowler, this is in accord with the general theory, energies of activation for migration of adsorbed, activated adsorbed, and chemi-adsorbed molecules being in general necessary and of different magnitudes.

The increase in rate of activated adsorption with the temperature and the energy of activation calculated therefrom must be ascribed either to an increase in the number of doublets formed by thermal agitation of the metal or alternatively to an increased rate of diffusion of the activated adsorbed molecules (in some cases possibly as atoms) away from the doublets. Both factors may indeed be operative over certain ranges of temperature. That activated adsorbed gas can actually leave the seat of activation and migrate over the substrate was evident from the communication of Frumkin and of Egerton and Ubbelohde, and a distinction between the two hypotheses is also possible by an examination of the effects of poisons on the process, as exemplified by the work of Maxted.

Whilst the pressure retention curves both for adsorption and activated adsorption over considerable ranges of pressure and temperatures obey the isotherm of Langmuir, examples of change of state of the adsorbed gas or vapour, as exemplified by the interesting work of Farkas and Bonhoeffer on the para-ortho hydrogen inversion on nickel surfaces, are by no means uncommon, for example,

cæsium on tungsten, examined by Langmuir. Even more remarkable, however, are the minor discontinuities or steps observed by Allmand, Burrage and Chaplin for the adsorption of vapours such as carbon tetrachloride and sulphur dioxide on charcoal and on silica gel, and by Benton and White for hydrogen at low temperatures on metals and nitrogen on copper and iron.

The phenomenon appears to occur with normal adsorption rather than with activated or chemisorption, and is ascribed by Benton to prefer-

ential adsorption on various selected portions of the substrate, such as the edges and corners of the micro-crystals of the metal.

It is probable that many of the visitors to this large and well-organised meeting came with the idea that only one type of adsorption was certain, but it is almost inconceivable that they left Oxford without being conversant with at least three types of adsorption, the characteristics of which could easily be recognised but the nomenclature of which remained undetermined. ERIC K. RIDEAL

### Obituary

SIR WILLIAM SOMERVILLE, K B E, LL D.

ALTHOUGH illness led to his retirement from active work some years ago, the sudden death from pneumonia, on Feb. 17, of Sir William Somerville, emeritus professor of agriculture and rural economy in the University of Oxford, came as a shock to many friends. To the progress made by agricultural education during the past fifty years his contribution was outstanding. Those who knew Somerville only in the committee room or common room, even those who recognised in him a delightful companion in the open air, equally at home in the field and woodland and garden, happy with a gun under his arm, but, above all, content with a rod in his hand and a meerscham pipe between his lips, must sometimes have asked themselves how it was that among practical farmers his reputation was unrivalled, and why among foresters his opinions on arboricultural questions were so highly valued. Other notices of him have dealt with his later career; here reference will be made chiefly to his early work in the years when he acquired the experience which made him in later life so valued a counsellor.

Somerville had attended the agricultural class at the University of Edinburgh when John Wilson was professor, but I do not think that he then had any intention of taking up agricultural education as a career. When Robert Wallace moved from Cirencester to succeed Wilson at Edinburgh in 1885, Somerville, attracted by the energy and reputation of the young professor, resumed his interrupted studies; he was class medallist in Wallace's first year, and when he had graduated at Edinburgh and at Munich, I believe it was the influence of Wallace that led him to adopt teaching as a profession. He considered the offer of an appointment in India in 1889, but for family reasons he then decided not to leave Edinburgh, and being specially interested in forestry, which he had studied in Munich, Somerville began his career as lecturer in forestry in his own University.

In 1891, Somerville went from Edinburgh to Newcastle-upon-Tyne as professor of agriculture and forestry in the Durham College of Science (now Armstrong College). Reference to his work there is made below. In 1899 he was elected Drapers' professor of agriculture at Cambridge. He was the first occupant of this chair, and the two years which he spent in Cambridge were devoted to the organisation of the new department, the provision of a farm

for experimental work, and to establishing contact with farmers in the eastern counties. In 1901 he left Cambridge on being appointed an assistant secretary in the Board of Agriculture and Fisheries, but the multifarious duties which tie an assistant secretary to a Whitehall desk were little to the taste of a man with Somerville's love for the field and woodland, and in 1906, when an opportunity of returning to educational work presented itself, he accepted the Sibthorpian professorship at Oxford, and there the rest of his working life was spent.

When he settled in Oxford, Somerville had two objectives. In his official capacity it was his duty to develop there a course of study suited to the needs of the Oxford student. It was clear that the special circumstances of those likely to inherit land or to undertake estate-management must be kept in view, and to them Somerville was specially fitted to act as friend and guide. But Somerville's ideals were not satisfied by lecturing on principles. He held it to be his duty to practise as well as to teach; he therefore acquired and farmed land in two English counties. He had had much experience in experimental work, but here his object was demonstration, not experiment—his farms were run on commercial lines. He knew that he could make farming pay, and he did.

Somerville's concentration on teaching and demonstration in his later years gave rise to an impression that his interests lay chiefly in practical farming, and that by nature he was not an experimenter who loved his work for its own sake. This was not the case. In his early years Somerville was an enthusiastic and indefatigable experimenter. He was not prepared to take statements on trust. His motto, indeed, was 'Prove all things', and he followed up this injunction by holding fast to what he found to be good. In public discussion, once his point of view had been stated he was very difficult to move; he always had facts ready if his views were challenged. But Somerville was by no means dogmatic; he would weigh deliberately points put to him in conversation, and was as ready to agree as to differ. His attitude when his views were challenged in public, those who knew his early work can explain and can justify.

When Somerville went to Newcastle in 1891, his knowledge of the subjects then interesting Scottish farmers and his German training in scientific methods enabled him both to grasp quickly those

questions on which farmers in the north of England required exact information and to devise field experiments of a kind likely to give the information needed. He was as active as he was methodical. He sought out farmers, got permission to use their land, and enlisted their interest so fully that most of the cost of the experimental work carried on was borne by them. The result was that in a belt of country between the Solway Firth and the North Sea numerous local stations were established and hundreds of experimental plots laid down. The purpose was strictly experimental, the sites selected were not intended for demonstration, for at the time it was not known how crops would respond to the special treatment. Some of these field stations were used for demonstrating results, but this use came at a later stage.

The range of Somerville's field experiments was wide. In the early years the crops of arable land and meadow hay were prominent subjects, the work on pastures with which his name was afterwards identified began in 1896. Most of the local experiments related to the effects of manures, but other subjects such as the prevention of finger-and-toe in turnips, lucerne inoculation, and a study of the productiveness of important pasture plants occupied his attention.

After the acquisition of Cockle Park Farm by the Northumberland County Council in 1896, experiments on arable land were extended to a group of miniature farms, permanent meadow plots were laid down, experiments in cattle and sheep breeding were initiated, a series of experimental plantations, including the chief forest trees, was formed, and the well-known work in 'Tree Field' was begun. Animals (in this case sheep) were used to measure the changes brought about in pastures by different fertilisers, for Somerville then realised, as does the biochemist to-day, that the apparatus and reagents of the laboratory may fail to detect subtle differences in the food of animals.

Somerville was a keen observer, he kept careful notes, he used the weighbridge wherever its use was applicable, and he accumulated a mass of data on which his reports were based. By 1899, when he left the north of England, he had published eight reports on his work. These reports extended to more than 800 octavo pages, they contained many thousands of figures and much discussion of experimental results.

Somerville not only worked hard, but he worked also in favourable circumstances. His district provided a wide range of soil types and several markedly different climates. These were just the conditions likely to supply hints for further experimental studies to a pioneer investigator. This was not all. It was his good fortune to work among observant and intelligent men, holding very definite opinions acquired as the result of their own experience, but men not unwilling to learn if satisfied that their instructor's knowledge, like their own, had been acquired at first-hand. Lectures were not greatly appreciated, but discussions were enjoyed, and might be protracted.

Somerville took a deep interest in his pupils, and

this interest was shared by his gifted wife, in term time they kept open house, and any Sunday visitor would find a gathering of students there. Nor did interest end when undergraduate days ceased, former pupils were frequent visitors. Pupils and Oxford colleagues combined to present him with his portrait in 1924. Thereby they earned the enduring gratitude of Somerville's friends, for the man himself stands out in Mr Hall Neale's picture. The stalwart build, the familiar pose, the well-coloured meerschaum, the twinkle in the eyes—they are there, and any visitor to Oxford may see what manner of man William Somerville was. Linking the skilled practice of the nineteenth century with the new knowledge of the twentieth, he commanded the confidence of farmers and foresters, the respect of his pupils, and the affection of his friends.

THOMAS H. MIDDLETON

#### SIR FREDERICK ANDREWES, O B E , F R S

F. W. ANDREWES was born at Reading in 1859. He was educated there and at Oxford, where, from Christ Church, he took a first class in the final honour school of natural science in 1881. He was afterwards Burdett-Coutts scholar and held the Sheppard medical fellowship at Pembroke. In 1882 he went to the Royal Hospital of St Bartholomew with an open scholarship to pursue his medical studies, and remained in intimate association with that institution for the rest of his life.

At first Andrewes dabbled with practical medicine and was at one time in professional charge of the nursing staff at Bart's and an assistant physician at the Royal Free Hospital. But after Kanthack was translated to Cambridge in 1897, he settled down to pathology, and for thirty years was head of that department and in due course a professor in the University of London. He retired in 1927, though he went on with his own laboratory work until a few months ago. In the summer of 1931 he had a desperate illness while on a visit to New York, from which he made a remarkable recovery, but he died from an extension of the disease on Feb 24. He was elected F R S in 1915 and knighted in 1920.

Andrewes' interests were always clinical and he looked on pathology as something which promoted good medical and surgical practice. He was little concerned with general and academical problems. In this field he was extraordinarily successful, primarily at his own hospital and indirectly elsewhere, in drawing the laboratory and clinical practice together and showing his medical colleagues by actual experience that bacteriology could be a great deal more useful to them than they had supposed.

In those days this was more difficult than it is now, and Andrewes owed much of his success to his sympathy and personality and his capacity for seeing points of view other than his own. Many of his assistants and colleagues in the pathological department were clinicians, and one of the pieces of work for which he is best known is his investigation with T. J. Horder of the streptococci pathogenic for



man Their classification was put forward in 1906 and has formed the working basis of innumerable subsequent inquiries, it is only in the last few years that further progress has shown that their criteria of differentiation are not wholly adequate in the systematisation of a difficult group

Throughout his career Andrewes was so constantly adding here and there to bacteriological knowledge that it is difficult to pick out particular pieces of work and it would be tedious to enumerate them all During the War, he became interested in the serological analysis of dysentery and typhoid-like organisms, and in 1922 made an important contribution to what has since proved to be a singularly fertile field In morbid anatomy he published little one recalls his definition of the histological characteristics of Hodgkin's disease in 1911 and a chemico-anatomical study of degenerate arteries in 1912

Andrewes was one of the few pathologists of his day who could write and talk with clarity and distinction it was always a pleasure to read or listen

to him Amiable and witty, he was universally popular, and he will be very much missed His son, Dr C H Andrewes, has already made his mark as a member of the research staff of the Medical Research Council

We regret to announce the following deaths

Mr Andrew A Blair, formerly chief chemist of the United States Geological Survey, known for his work in the chemical analysis of iron and steel ores and alloys, on Jan 25, aged eighty-three years

Prof E H Griffiths, F R S, honorary fellow of Sidney Sussex College, Cambridge, formerly principal and professor of experimental philosophy in the University College of South Wales, on March 3, aged eighty years

Mr H Chapman Jones, formerly for many years senior demonstrator in chemistry in the Royal College of Science, London, on March 7, aged seventy-seven years

### News and Views

#### Royal Society's Selected Fellows

THE following seventeen candidates have been recommended by the Council for election to the Royal Society Prof F C Bartlett, professor of experimental psychology in the University of Cambridge, Prof Davidson Black, professor of anatomy in the Union Medical College, Peking, and honorary director of the Cenozoic Laboratory of the Geological Survey of China, Dr F W Carter, consulting engineer to the British Thomson-Houston Co, Ltd, Rugby, Prof W G Fearnside, Sorby professor of geology and dean of the Faculty of Science in the University of Sheffield; Prof. F. E. Fritsch, professor of botany in the University of London (East London College), Prof J A Gray, Chown research professor of physics in Queen's University, Kingston, Ontario, Prof J B S Haldane, Sir William Dunn reader in biochemistry in the University of Cambridge, head of the Genetical Department, John Innes Horticultural Institution, and Fullerman professor of physiology, Royal Institution; Prof D R Hartree, Beyer professor of applied mathematics in the University of Manchester, Dr K Jordan, director of the Zoological Museum, Tring, Prof F R Miller, professor of physiology, Faculty of Medicine, University of Western Ontario; Sir Basil Mott, Bt, past president of the Institution of Civil Engineers; Dr J B. Orr, director of the Rowett Research Institute, Aberdeen, Prof J L. Simonsen, professor of chemistry in the University College of North Wales, Bangor, and formerly professor of organic chemistry, Indian Institute of Science, Bangalore, Mr T Smith, head of Optics Section, National Physical Laboratory, Prof H S Taylor, professor of physical chemistry and chairman of the Department of Chemistry, Princeton University, U.S.A., Prof H. W. Turnbull, professor of mathematics in the University of St Andrews, Prof Warrington Yorke, professor of tropical medicine at the Liverpool School of Tropical Medicine, University of Liverpool.

#### Royal Society of Edinburgh Elections

AMONG the fellows elected into the Royal Society of Edinburgh at a meeting held on March 7 were the following associated with scientific work E C Barton-Wright, chief assistant to the Scottish Society for Research in Plant Breeding, Edinburgh, Major S L Bhatia, professor of physiology and Dean, Grant College, Bombay, Prof J C Brash, Department of Anatomy, University of Edinburgh; Prof E P Cathcart, Department of Physiology, University of Glasgow, Prof. V. Gordon Childe, Department of Prehistoric Archaeology, University of Edinburgh; Dr. David Clouston, formerly agricultural adviser to the Government of India and director of the Imperial Agricultural Research Institute, Pusa, Prof L S P. Davidson, Department of Medicine, University of Aberdeen, Prof A Murray Drennan, Department of Pathology, University of Edinburgh, Prof Andrew Hunter, Department of Biochemistry, University of Glasgow, J. B. Lockhart, mathematical master of Edinburgh Academy and honorary treasurer of the Edinburgh Mathematical Society, A G MacGregor, geologist, H M Geological Survey (Scotland), Prof. J J R Macleod, Department of Physiology, University of Aberdeen, Prof Charles McNeil, Department of Child Life and Health, University of Edinburgh, J M Murray, divisional officer, Forestry Commission, Edinburgh, M Y Orr, botanist in government service, Edinburgh, Dr J N. Pickard, research worker in genetics and physiology, University of Edinburgh, Dr G Prasad, reader in mathematics, University of Allahabad, Prof. T Slater Price, Department of Chemistry, Heriot-Watt College, Edinburgh, Dr John Pringle, senior geologist, acting palaeontologist, Geological Survey (Scotland); Dr J M Robson, research worker, Institute of Animal Genetics, University of Edinburgh; A R Barbour Simpson, senior geography master, Cranford School, Wimborne, Dorset, J. B Simpson, geologist, H M.

Geological Survey (Scotland), Dr J-B O Sneed, lecturer on heat engines, Royal Technical College, Glasgow, Dr W E Swinton, curator of fossil reptiles and amphibia, British Museum (Natural History), Henry Wade, senior lecturer in clinical surgery, University of Edinburgh

#### Royal Horticultural Society

THE unveiling of a plaque commemorating the foundation of the Horticultural Society in 1804 (designated 'Royal' in 1861, during the presidency of the Prince Consort), the initial proceedings of which were conducted in a room at Messrs Hatchards, booksellers, Piccadilly, London, was the occasion of a representative gathering on March 7 at the firm's establishment, which is on the site of the older house. It is claimed that London annals do not provide any precedent recording in this way the foundation of a society having scientific relationships. The plaque has been placed on the face of the building in Piccadilly, whilst an illuminated record, inscribed with the names of the original promoters, is placed inside. These were The Right Hon Charles Greville, Sir Joseph Banks, John Wedgwood, R. A Salisbury, W T. Aiton, William Forsyth, and James Dickson. The unveiling ceremony was performed by the Hon Henry McLaren, president of the Society, and Mr Gerald Loder, past president.

At the original meeting of the Horticultural Society in 1804, John Wedgwood (1766-1844) was chairman. He was the eldest son of the illustrious Josiah Wedgwood, and was strongly attached to horticulture, notwithstanding the limitations of the period. An early paper of his dealt with the propagation of dahlias. Some proposals that Wedgwood drew up, accompanied by useful notes, were largely instrumental in bringing the Society into being. He had observed the rise of societies for the improvement of agriculture—the British Mineralogical Society of that time was actively engaged in examining specimens of earths or soils to aid the science of husbandry—but no organisation existed for the sole purpose of encouraging horticulture. Hence, the object of the newly formed Society was the collection of information respecting the culture and treatment, culinary as well as ornamental, of plants and trees, and the publication of papers on horticultural subjects. From modest beginnings, the Society has now achieved a membership of 27,000.

#### Faraday's Work in Electrochemistry

The subject of Sir Harold Hartley's Friday evening discourse at the Royal Institution on March 4 was "Michael Faraday and Electrochemistry". From 1832 until 1834 Faraday was mainly occupied with electrochemical researches. He first showed that amounts of electricity which produced the same effect on a galvanometer also liberated the same amount of iodine when passed through a solution of potassium iodide. He then went on to systematic investigation of the amounts of different elements which are liberated when the same current is passed through a series of solutions or fused substances, and established the two fundamental laws of electrolysis which still stand

as the quantitative basis of electrochemistry. He investigated also the mechanism by which a current passes through an electrolyte, and his ideas were crystallised in the nomenclature which he devised with the help of Whewell. All his new names—ion, anion, cation, electrode, and electrolysis—we use to-day with the significance which Faraday gave to them. In addition, he explored the source of the energy of the voltaic cell and forecast its relation to the affinity of the chemical reaction taking place in the cell. With the help of extracts from Faraday's diary, Sir Harold traced the development of Faraday's electrochemical work, repeating the decisive experiments which were the milestones of its progress. Faraday's electrochemical researches rank among the highest of his achievements. They were carried out in a short space of time with amazing economy of effort—it took him only two days to establish a connexion between the quantity of electricity and the amount of chemical action due to it—thanks to the combination in Faraday of brilliant imagination, unerring instinct for essentials, and unrivalled mastery of experimental technique, and his main conclusions still hold good to-day.

#### The Aryans

SIR ARTHUR KEITH's Frazer lecture on "The Aryan Theory as it stands To-day", which was delivered in the University of Glasgow on March 4, was lacking neither in courage nor in imagination. Much water has passed under the bridge since Max Muller was accused of confusing race and language. Sir Arthur, holding that race and language are two aspects of one problem, nevertheless admits that for clearness we should have one name for the languages of Europe and another for its peoples, namely 'Caucasian'. From a reconsideration of the problem in the light of the evidence which has accrued recently from Ur, Kish, and Susa, and a survey of the distribution of racial types in early times, he derives the Caucasians from the plateau extending from Mesopotamia to India, for which he suggests the name 'Gedrosian'. In rejecting Europe as the place of origin of the Aryan tongues and practically reverting to the area west of the Pamirs put forward by Max Muller, Sir Arthur relies on the evidence of prehistory that down to somewhere about 3000 B.C. the culture of Europe was of too rudimentary a type and its inhabitants too few to make it probable that migration was to, rather than from, the highly organised agricultural communities of the east. It will be seen that Sir Arthur gave his hearers much material for careful pondering, his views implying a frank acceptance of racial and linguistic anomalies difficult to explain on any theory. He went further and asked of the Aryan theory that it should explain the triple racial zone of Europe and the diffusion of the Aryan tongues.

#### Forecast and Fact in Science

THE fourteenth annual Earl Grey Memorial lecture of Armstrong College (University of Durham) was given on March 3 by Dr R. A. Sampson, Astronomer

Royal for Scotland, on "Forecast and Fact as seen by an Astronomer". Dr Sampson began by showing how man has transformed the world by his intellect, pointing out that such discoveries as those of Michael Faraday will live for ever, while the work of man's hands will crumble away. The world is growing more and more dependent upon science, and the changes brought about by science are for the good of humanity. Yet man cannot become superior to Nature. Nature is complicated, and the physicist is apt to go too far when he views it as something precise when it is really something vast, the mysteries of which can only be guessed. Forecast in science is, therefore, like a shot fired at an unseen target, the starting-point is clear, but afterwards we enter into unknown country, and next to nothing is really known of remote epochs in the future. Many great prophecies, such as the 'heat death' theory, representative of what has been put forth in the name of mathematical certainty, are only of value scientifically if they are certain; but as science advances and ideas change, are they certain? A distinction should be made between the immediate applications of science and the wider claims that are sometimes made for it, and scientific forecast should be taken with a grain of the salt of common sense. Scientific workers, however, realise that all they really know is due to men like Faraday and Einstein, who do not think of practical results. The theoretical mind is the soul of science—the prophetic soul dreaming of things to come; but one should read any scientific forecast as one would read an imaginative poem.

#### Institute of Chemistry

At the fifty-fourth annual general meeting of the Institute of Chemistry, held on March 1, the president, Dr G. C. Clayton, presented the Meldola Medal, the gift of the Society of Maccabæans, to Dr G. F. Marrian, of University College, London, in recognition of his researches on vitamins and hormones. In moving the adoption of the Report of the Council, Dr Clayton said that the roll of fellows and associates of the Institute now exceeds six thousand. The proposal to petition for a supplemental Royal charter, with the view of securing for members the use of the title "Chartered Chemist", has been postponed. The examinations arranged by the Board of Education and the Institute jointly for National Certificates in Chemistry are proving of real value in co-ordinating and raising the standard of chemical training in technical colleges. Referring to the separate publication of various lectures, including Sir Frank Smith's Gluckstein memorial lecture on "Chemistry and the Community", Dr Clayton emphasised Sir Frank Smith's view that, even in these difficult times, chemical research must be continued. New problems are awaiting solution, and many which have been solved are yet to be developed on the large scale. Chemical industry is an excellent barometer for indicating the outlook in industry generally, because it supplies some of the materials required for so many industries, and signs of a change for the better are

not lacking. The Appointments Register Committee of the Institute reports that about 190 (or rather more than 3 per cent) of the members are without appointments, the number of unemployed qualified professional chemists in Germany is 1500 out of about 10,000 (15 per cent). Dr G. C. Clayton was re-elected president of the Institute.

#### Education in Public Schools

THE headmaster of Eton gave a very interesting and suggestive address, which has recently been printed, on "The Education of the Average Man", at the Royal Institution on Dec 18. His humour and open-mindedness, and his wide and special knowledge of the public schoolboy, command a sympathetic hearing for his views; and with the general tenor of them most people will agree. He deploras the constriction caused by the examination system, thinks the boys are called upon for a sort of all-round specialism which it is impossible to achieve and is calculated mainly to engender a distaste for further learning, and would himself lay stress on three great aims—accuracy, curiosity, and observation. He speaks frankly as the spokesman of the public schools, which he describes as lying between the upper and nether millstones of the preparatory schools and the university examiners. In all of this there is much sound criticism and good sense; but one is bound to recognise the limitations of Dr Alington's point of view. He is almost entirely critical, except of these public schools which are to him the one virtuous element struggling with adversity, and he is also almost entirely *laudator temporis acti*, the older system, as he himself knew it, seems almost always preferable.

WITH all possible sympathy and thanks, one must put one or two larger questions than Dr Alington has raised. Is he really content with the ideal that the education of the élite of the young men of Great Britain should go on indefinitely on the lines of a simple bifurcation of 'sides' as between classics and mathematics, which is what he seems to imply? The classics boy, which is what he was himself, is not to be bothered with the algebra which he cannot understand, and is to have some general or recreative lessons or lectures on science, literature, and history. Would he not agree that with improved methods far more might be done without distaste or overloading, and, in particular, that a modicum of mathematics is desirable for the average boy, this modicum to include an introduction to the calculus? As to history and literature we are inclined to agree with him that they are not suitable subjects for examination, certainly not for the present type of examination. But as to the scope of the history taught we should go much further than he suggests. History and the historical spirit are in fact the new element in human thought, which is bound to become, we will not say dominant, but reconciling, in the increasing complexity of the curriculum. Through that alone we may hope to gain some harmony and a simplification of the mass of knowledge we have to face.

### Association of Technical Institutions

THE annual general meeting of the Association of Technical Institutions was held in the Leathersellers' Hall, London, on Feb. 26-27. Sir John Dewrance was elected president for the year 1932. Among the papers read to the meeting were "Technical Education and the Bakery Trade", by W. H. Quinn of the Leeds Technical College, "Technical Education in Canada", by Prof. R. W. Angus of the University of Toronto, and "The Teaching of Modern Languages in Technical Colleges", by P. G. Wilson of the City of London College. Each of these papers contained special points of interest to those who govern and administer technical colleges, as well to those who seek, at this kind of conference, specialist information. It is possible, however, that interest in papers (which have already been printed and placed in the hands of those attending some days before the conference) is considerably lessened when they are again read exactly from their text. There is a procedure vaguely called 'speaking to the paper'; it may not always be the happiest procedure, but it has the merit of allowing the writers of the papers to bring out succinctly matters which are afterwards the points round which debates may swing.

PROBABLY the *pièce de résistance* of the meeting was the report on "Policy in Technical Education". It had been drawn up by a Joint Committee of the Association of Technical Institutions and the Association of Principals of Technical Institutions. It was accepted, and will doubtless be discussed further by other interested bodies. Indeed, the charge was made at the meeting that an earlier consultation might have been made with bodies representing local education authorities. Whether that charge could be sustained or not, however, the recommendations are such as might be strengthened by help from other interested bodies. They do not present what might be called new ideas for the better conduct of technical education. Indeed, the majority of them have already been passed in resolution form by at least one other body, and have received publicity in our own columns and those of other, more purely educational, journals. But their present grouping will do much to help their translation into practice. In particular we welcome the recommendations urging administration of technical colleges on a regional basis (industry does not organise itself in local units), closer co-operation with universities, increase of full-time senior day technical courses, the extended provision of junior technical schools as an alternative form of secondary education (including arrangements for transfer at appropriate ages from one form of secondary education to another), the development of the teaching of industrial economics, and of facilities for physical training and social activities.

THE first part of the work undertaken by the Commission on Educational and Cultural Films—the preparation of a report on the use of the cinematograph in the service of education and social progress—is now drawing to a close. The report is in progress of com-

pletion, and will be considered at a full meeting of the Commission in April. The researches of the Commission have been far-reaching, and the conclusions deal not only with the advantages to be derived from cinematography within the narrow limits of scholastic education, but also with its cultural influence in the public cinema. The emphasis laid at successive meetings of the Imperial Conference on the assistance which motion pictures can give to the stimulation of Imperial trade and scientific research, combined with the investigations of the Colonial Office into their use among native races of the Empire for educational, medical, and agricultural instruction, present cinematography in a new light as a bond of unity in the British Commonwealth of Nations. A study of the organisation of film institutes in foreign countries leads to the consideration of the possibility of a similar national institution which will apply constructive ideas to cinematography both in Great Britain and throughout the Empire. The Commission has been impressed by the need for a central organisation capable of distributing information concerning the use of motion pictures in all departments of activity. If provision can be made for the Commission to continue its work for a while, it is proposed to take as the main object the preparation, in conjunction with educational associations, of a catalogue of films approved for use in teaching and in research.

### Gallium, a Commercial Product

WITH reference to the paragraph in NATURE of Feb. 27 (p. 309) on the commercial production of metallic gallium at a moderate cost by the Vereinigte Chemische Fabriken at Leopoldshall, Stassfurt, it was stated that the price ruling about twelve months ago for the commercial metal was about 175 gold marks per gram. This price was quoted from the *Chemiker-Zeitung*. Messrs. Adam Hilger, Ltd., inform us that they have been able to supply, not the commercial metal, but highly purified gallium, since October 1925, together with a spectrographic report upon the residual impurities in it, at prices ranging between £5 10s. and £6 10s. per gram. The chief impurity contained in this material is indium (0.8 per cent), though slight traces of lead and silver were also found. Messrs. Hilger also state that they are now in a position to supply, at £5 5s. per gram, together with a still more detailed spectrographic report, a product of even greater purity, which has been extracted electrolytically from the oxide in the research laboratories of the Sir John Cass Technical Institute, London.

### Species Hybridisation in Animals

A BOOK on species hybridisation in animals is very badly needed, but would involve much labour in its compilation, as, although there is a good deal of information on the subject available, it is very much scattered. A notable and well-illustrated contribution is that of Mr. R. I. Pocock in the *Field* for Jan. 30, on captive-bred hybrids between the lion and the tiger, apropos of the recent death of the well-known specimen at the London Zoological Gardens. This animal was bred in India between a tiger and a lioness, and

resembled a lioness with stripes; these were very faint. A mane was present, but so poorly developed that it could be rivalled by the frill of some tigers. Mr Pocock, on the other hand, has met with a specimen in which the colour was so rich that it resembled rather a stripeless tiger, and it may be mentioned that others have been bred in which the stripes, though not so strong as in the pure tiger, are quite noticeable, one such is figured, as well as the Zoological Gardens specimen, but not mentioned in the text. These hybrids appear to be always sterile, and because of this, and because of the lesser distance between the parent species, are less interesting than the hybrids between the male polar and female brown bear which were bred in Germany before the War. These were fertile, at any rate with the polar bear, one of the three-quarter-bred animals was like the latter, with a brownish back, a first cross being brown with a white polar-bear-shaped head; both were on view at the London Zoological Gardens.

#### 'Bullying' amongst Birds

IN *Cage Birds* for Jan 23, p 62, R E D Barrington records a curious case in which a female siskin, which had been persistently bullying a male before a blue-fronted Amazon parrot, was, after careful inspection, pulled through the bars of the cage and killed by the latter after it had been released from its own. This disposition to interfere in the quarrels even of alien species in what we should call the cause of justice appears to be widely spread in birds, judging from occasional instances which the writer has witnessed. A gannet thus interfered between two greater black-backed gulls, striking one which had injured and was pursuing the other, a female ruddy sheldrake forced a male common sheldrake to drop a mallard duckling which he was holding up by the tail, a piping crow-shrike (*Gymnorhina*) habitually attacked a magpie when it was bullying some other bird of the crow tribe, jay or jackdaw, and ultimately, it was said, killed it. These were captive birds, but Indian house-crows at large attacked a kite which was plucking alive a dabchick, not by the usual stealthy manoeuvres with which they often try to rob this bird of its food, but by a fierce direct assault, which seemed to suggest a sympathy one would certainly not have expected in crows. He has seen no similar instance in mammals, but Romanes, in "Animal Intelligence", records what seems like one, when a very sensitive terrier would seize his sleeve if, when driving, he touched the horse with the whip, in evident deprecation.

#### Archæological Expedition to the West Indies

It is announced by the Smithsonian Institution that, in pursuance of the plan for a systematic anthropological and zoological survey of the West Indies, Mr Herbert W Krieger, a curator of ethnology of the Institution, is proceeding to the little-visited San Salvador and Cat Islands of the Bahamas as a 'one-man expedition' of archæological investigation. The specific object of the expedition is to identify the "naked, painted Indians, with fine high foreheads" who were the first inhabitants of the New World to be encountered by Christopher Columbus. It is by

no means certain which island was the scene of Columbus's first landing; though San Salvador would appear to have the best claim. The record of the appearance of the Indians affords little clue to their identity, but Mr Krieger is of the opinion that the fact that several of these islanders served Columbus as interpreters along the coast of Cuba, up to a point to the west where their language was no longer understood, suggests that they may have been of the Arawak stock. It is known that the inhabitants of the Cuban coast were Arawak. It is possible, however, that they may be entirely unrelated. Mr Krieger's previous investigations in the West Indies have revealed evidence that the Arawak were preceded by a race of primitive non-agricultural people who lived in caves, and of whom rumours appear in the writings of the early Spanish chroniclers. Mr. Krieger will follow up his investigations in the Bahamas by an examination of the shell-heaps of central Cuba, which previously has not been explored archæologically.

#### Hydroelectric Power in Southern Scotland

THE central area of Scotland will soon be largely supplied with electric power by three water power companies. Two of them, the Grampians Electricity Supply Company and the Lanarkshire Hydro-Electric Power Company, are already operating, but it will be three or four years' time before the Galloway Water Power Company will be in a position to supply. The Galloway Company will shortly begin to build five water power stations, of a total capacity of 102,000 kilowatts, extending from the neighbourhood of Loch Doon in Ayrshire to Tongland near Kirkeudbright. Four of these stations depend for their power on the falling level of the River Ken, the lower part of which is the Dee. The other station, Glenlee, gets its power from a large artificial reservoir to be formed by a concrete dam on the Black Water of Dee between Newton Stewart and New Galloway. It will store the run-off water from an area of about forty-nine square miles. The scheme provides for a dam across Loch Doon which will raise its level twenty-three feet. At present Loch Doon discharges itself by the River Doon into the Firth of Clyde. In future the main portion of its water, with the exception of the compensation water which the company must continue to supply to the River Doon, will be diverted into the River Ken. Thus it will flow into the Solway Firth. When this is done, the water in the Doon, made famous by Burns, will be very appreciably less in bulk, but its flow will be more uniform than at present. The greatest of the water power stations is at Tongland on the Dee, about  $1\frac{1}{2}$  miles above Kirkeudbright. A dam is to be built across the gorge, giving a fall of just over a hundred feet. The level of Loch Ken is to be raised several feet, so as to give additional storage for Tongland.

#### Proposed Ship Canal in France

THE ambitious project of a ship canal across southern France has lately been revived and is receiving some attention. In *Terre, Air, Mer* for February a few details of the scheme are given. The proposal is that the

canal should start at the port of Bordeaux, follow the River Garonne to Toulouse and then the course of the railways to Narbonne, and open into the Mediterranean at La Nouvelle, about twelve miles to the south. The course would be approximately that of the present barge canal that crosses from Atlantic to Mediterranean and about 250 miles long. But the new canal would have a depth of 44 feet and a width of nearly five hundred feet at the surface and about two hundred at the bottom. There would be fourteen locks, but apart from the delay at these, vessels would be able to maintain a speed of 14 knots. The gain in distance between, say, Southampton and Port Said by the use of the canal would be about twenty-three per cent of the total mileage.

#### Announcements

SIR WILLIAM J POPE, professor of chemistry in the University of Cambridge, has been elected chairman of Council of the City and Guilds of London Institute in succession to the late Dr Morton Latham.

DR B A KEEN, assistant director of the Rothamsted Experimental Station, will deliver the G J Symons memorial lecture before the Royal Meteorological Society, on March 16, at 7.30. The subject of Dr Keen's lecture will be "Soil Physics in Relation to Meteorology".

THE sixth International Botanical Congress will be held in Amsterdam on Sept 9-14, 1935. The following executive committee has been elected: *President*, Prof F A F C Went (Utrecht), *Vice-President*, Prof J C Schoute (Groningen), *Treasurer*, Dr W C de Leeuw (Bilthoven); and *Secretary*, Dr M J. Sirks (Wageningen).

A SYMPOSIUM entitled "Is the Carbon a Failure? a Symposium on Arc Illumination and its efficiency under present conditions in Studio and Cinema", will be held at a meeting of the British Kinematograph Society at the Gaumont British Theatre, Film House, Wardour Street, on April 4, at 7.45 p.m. Anyone interested in the subject is invited to attend the meeting.

SIR GEORGE BUCKSTON BROWNE, donor of Down House and of the Royal College of Surgeons Research Farm, Kent, Sir David Thomas Chadwick, secretary of the Imperial Economic Conference, and Mr Philip Guedalla, author of "The Duke" and other works, have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service.

At the annual general meeting of the Geological Society of London, held on Feb 19, the following officers were elected for this year: *President*, Sir Thomas Holland, *Vice-Presidents*, Prof E J Garwood, Mr J F N Green, Mr W Campbell Smith, Dr H H Thomas, and Prof W W Watts, *Secretaries*, Prof W T Gordon and Prof P G H Boswell, *Foreign Secretary*, Sir Arthur Smith Woodward, *Treasurer*, Mr F N Ashcroft.

THE PRINCE OF WALES will declare open Manson House, Portland Place, the new headquarters of the Royal Society of Tropical Medicine and Hygiene, on March 17, at 5.30. The Right Hon Sir Austen Chamberlain, with the president, Dr G Carmichael Low, will be present to receive the Prince. Admission will be by ticket only. A laboratory meeting will be held on the same day, at 8.15, at the Royal Army Medical College, Grosvenor Road, Millbank, by kind permission of the commandant, Colonel R B Ainsworth.

A PAMPHLET showing the provision made for professional and middle class people at voluntary hospitals in London, that is, the 'pay beds' available, has just been published for King Edward's Hospital Fund for London, by Sir Joseph Causton and Sons, Ltd, 9 Eastcheap, London, E C 3 (price 3d, post free). A useful preliminary statement describes the 'pay bed' system and the contributory schemes available in connexion with it. The 'pay beds' in London have increased from 590 in 1920 to 1577 in 1931.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.—A principal of the Sheffield City Training College for Teachers—The Director of Education, Education Office, Sheffield (March 14). An assistant aeronautical engineer in the Army Air Corps, Irish Free State—The Secretary of the Civil Service-Commission, 45 Upper O'Connell Street, Dublin, C 8 (March 18). An inspector for general duties and two inspectors for live-stock duties, under the Department of Agriculture for Scotland—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (March 19). A whole-time qualified research worker at the Hospital for Consumption and Diseases of the Chest, in connexion with the Halley Stewart Grant for Investigation of Tuberculosis in Children—The Secretary, Hospital for Consumption and Diseases of the Chest, Brompton, S W 3 (March 19). A clinical assistant and research student at the Cardiff City Mental Hospital—The Medical Superintendent, Cardiff City Mental Hospital, Whitechurch, Cardiff (March 21). Two whole-time veterinary inspectors under the Agricultural Committee of the East Sussex County Council—The Director of Agriculture, County Hall, Lewes (March 29). A Jenner memorial student in bacterial chemistry at the Lister Institute of Preventive Medicine—The Secretary, Lister Institute, Chelsea Bridge Road, S W 1 (April 8). An assistant lecturer in mathematics at the Royal College of Science—The Secretary, Imperial College of Science and Technology, South Kensington, S.W 7 (April 11). A geneticist and botanist at the Institute of Plant Industry, Indore, Central India—The Secretary to the Board of Governors, Institute of Plant Industry, Indore, Central India (applications from the Orient), The High Commissioner for India, India House, Aldwych, W C 2 (applications from Great Britain and overseas) (in each case June 9). A director of the National Institute for Research in Dairying, University of Reading—The Secretary, National Institute for Research in Dairying, Shinfield, near Reading.



## Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.*]

## Oxygen and Everest

THE discussion at Section I of the British Association, following Prof J Barcroft's paper, as well as Dr. Greene's article<sup>1</sup> and the correspondence from Dr. Greene and Mr N E. Odell<sup>2</sup> which have followed, on "Oxygen and Everest", suggest that there is no accord among physiologists as to whether oxygen may be of assistance to climbers at very high altitude. In reality, Dr Greene's "oxygen school" and "no-oxygen school" do not exist at all. All physiologists agree in believing that the limiting factor of altitude is, roughly, the alveolar partial pressure of oxygen.

A few years ago Talenti<sup>3</sup> brought some people breathing 98 per cent oxygen in a steel chamber down to a pressure of 115 mm mercury, which corresponds to a utilisable oxygen pressure of 67 mm. mercury

$$\left[ (115-47) \times \frac{\%O_2}{100} \right]$$
 The limit to low barometric pressure breathing air may be fixed at about 300 mm mercury (Margaria, 1929), which corresponds to a utilisable oxygen pressure of 53 mm mercury. As people when brought to low barometric pressures showed a much higher pulmonary ventilation when they breathed air than when they breathed oxygen, so the alveolar oxygen pressure ought to have been very nearly the same in both cases. This fact alone would be sufficient to show that practically the only difficulty due to altitude is the low oxygen tension, and that when it is removed by increasing the oxygen tension in the air, the limiting altitude would be increased. In view of these facts and my results<sup>4</sup> on the working capacity of men breathing air at various barometric pressures, we had very little doubt when we tried climbing experiments in the low barometric chamber in Oxford (Barcroft, Douglas, Kendal, and Margaria)<sup>5</sup> of the success of the experiments.

These experiments showed once more, directly, that a man can work at a much lower barometric pressure than that existing on the top of Mount Everest if the utilisable oxygen pressure is kept to a sufficiently high level.

The only thing which may have raised some doubt about the utility of oxygen, climbing at high altitudes, was the report of the Everest expedition of 1924, when climbers did not get any appreciable advantage from 'breathing oxygen'. We must first criticise what 'breathing oxygen' meant in that case, and see if the experiments on Everest have been carried out with a technique good enough to justify the striking conclusions at which they arrived.

The breathing apparatus used in that Everest expedition (Odell) was 33 lb (15 kgm) weight, had a capacity of 1605 litres oxygen, and was arranged to give a delivery at continuous flow of a maximum of 2 litres per minute: the oxygen was conveyed by a rubber tube to a pipe kept between the teeth. Now assuming a utilisation of 75 per cent of the oxygen in this way, and a pulmonary ventilation of, say, at least 30 litres per minute, the percentage of oxygen in the inspired air must have been raised from 21 to 24.4, due to the extra oxygen, and the utilisable oxygen pressure from 43 mm to 50 mm mercury. So the effect of the 'breathing apparatus' was, in the most

favourable conditions, to raise the utilisable oxygen pressure only 7 mm. We can scarcely believe that this value was high enough to compensate for the greater work necessitated by a heavy apparatus, the trouble of looking after it—for it needed continuous care—and the difficulty of working with the pipe between the teeth, with an open mouth, and doing complicated movements to prevent oxygen flowing during the expiration.

In this way we can explain why in the last Everest expedition climbers did not get any advantage from the oxygen, but that is not due to the oxygen being of no value, but because the principle of the oxygen apparatus was wrong and did not increase the oxygen tension in the inspired air to an appreciable extent. Such an experiment cannot form the basis for a 'no-oxygen school'.

There is no doubt then that oxygen, if supplied in sufficient amount by a good breathing apparatus, is useful for the climber at high altitude, the experiments in the pressure chamber were carried out on subjects not acclimatised to low barometric pressure, though the climbers of Mount Everest arrive at the point of attack of the mountain already acclimatised, after weeks of walking at high altitude. The doubt of some climbers as to whether the experiments in the pressure chamber are comparable to the experiment of real climbing, owing to the difference in acclimatisation of the subjects, has not much ground, in fact there is no reason to suppose that the acclimatisation to low barometric pressure decreases the resistance to the low oxygen pressure, when pure oxygen is breathed. On the contrary, this is very probably increased by acclimatisation to high altitudes.

So there remains only what Prof Barcroft calls 'the problem of the engineer', that is, the construction of a suitable apparatus for the respiration of a rich enough oxygen mixture. The safest and simplest way would be, of course, to breathe pure oxygen from a mouthpiece or a mask. On this principle the expired air may be (a) wasted, that is, not utilised again, as we did in the chamber experiments, or (b) rebreathed after previous absorption of the carbon dioxide by soda lime.

In (a), assuming a pulmonary ventilation of 30 litres per minute at 250 mm pressure, the requirement of oxygen would be, for 5 hours climbing, 3000 litres of oxygen at 760 mm mercury, about 4.3 kgm. The transport of such an amount of oxygen would not be possible with oxygen gas because of the weight of the containers: it would only be possible with liquid oxygen, if it were possible to bring it to the highest camps and fill the specially constructed breathing apparatus with it.

As regards (b), assuming an oxygen consumption similar to that in the Oxford chamber, where the subjects made an ascent and descent of 1000 feet an hour, the amount of oxygen required would be, for a 5 hours' climb, not more than 450 litres or 0.64 kgm. To this the weight for the carbon dioxide absorber must be added, which, if it were caustic soda, would be 80 gm. for every 32 gm of oxygen, assuming a respiratory quotient of 1, assuming an efficiency of 50 per cent of the caustic soda absorber, the weight of it ought to be 3.2 kgm, making altogether about 3.8 kgm. Then the 'engineer' ought to be able to provide a suitable breathing apparatus with such amounts of oxygen and carbon dioxide absorber, which, together with the weight of the containers, does not weigh too much, say 20-25 kgm, and the breathing apparatus ought to be well tested, particularly as regard the action of cold on the functioning of the respiratory valves on the freezing of the condensed water in the tubes, etc. This could be tested on our Alps.

If it is not possible practically to use liquid oxygen or even oxygen gas because of the excessive weight of the containers oxygen could be provided by some peroxide, say sodium peroxide from the reaction  $2\text{Na}_2\text{O}_2 + 2\text{H}_2\text{O} \rightarrow 4\text{NaOH} + \text{O}_2$ , we see that we can get 1 molecule of oxygen for every 2 molecules of  $\text{Na}_2\text{O}_2$ . Then for case (a) 3000 litres of oxygen could be provided by 21 kgm of sodium peroxide, for case (b) 450 litres could be provided by 31 kgm, in this case the caustic soda resulting from the decomposition of the sodium peroxide could also be utilised for the absorption of carbon dioxide.

The relative practicability and suitability of the above methods is the 'problem of the engineer'. From the physiological point of view, the problem of reaching the top of Mount Everest is already solved within the limits of probability of biological experiments.

RODOLFO MARGARIA

Laboratorio di Fisiologia,  
Torino, Feb 2

<sup>1</sup> Greene, R., NATURE, 128, 893, Nov 28, 1931

<sup>2</sup> Odell, N. E., NATURE, 128, 1037, Dec 19, 1931

<sup>3</sup> Talenti, C., Arch. Sc. Biol., 14, 125, 1930

<sup>4</sup> Margaria, R., Arbeitsphysiologie, 2, 261, 1929

<sup>5</sup> Barcroft, Douglas, Kendal, and Margaria, Arch. Sc. Biol., 1932, in the press

MR ODELL's remarks,<sup>1</sup> regarding Dr Argyll Campbell's experiments, which were designed to test the power of acclimatisation of animals to low oxygen pressure, are not quite accurate. These experiments were undertaken to supply information that was wanting, and to endeavour to explain the adverse symptoms recorded in the official reports of the Everest expeditions. The animals were exposed to gradual decrease of oxygen pressure such as occurs in climbing. They showed all the well-known signs of so-called acclimatisation, for example, increase of red blood cells, increased depth of breathing, etc. Some of the experiments, unlike the expeditions, did not stop at a pressure equivalent to 28,000 ft but went on to one near 30,000 ft. Some of the animals were exposed to 7-7½ per cent of an atmosphere of oxygen for eight days continuously, and recovered completely when put under normal oxygen pressure again. In spite of heroic efforts, no man has been exposed to so low a pressure for even one day, and Dr Campbell's animals hold the record for toleration of low oxygen pressure by mammals.

It is impossible to tell what is happening to the organs of man, or of animals, under such conditions without post-mortem examination. The animals exhibited loss of appetite, weakness, and air hunger such as is described in the case of the climbers in the official reports. In view of the degenerations observed in animals' tissues, it is assuming a great deal to say that the Everest climbers did not, and will not, suffer any such degeneration. In any event, no climber has lived more than a day or so above 26,000 ft, and Dr Campbell's experiments with animals indicate what is likely to happen if they do remain longer.

Mr Odell states that the animals were completely inactive and thus could not acclimatise. This is erroneous, since the most active animals showed all the signs of so-called acclimatisation, and others showed relatively as much activity as was reported by the climbers at very high altitudes. Although strenuous exercise may hasten acclimatisation, it is not essential. In the case of Norton and Somervell it was evidently considered a disadvantage. The argument cannot be used both ways. No man or other mammal has been acclimatised completely to much below ten per cent of an atmosphere of oxygen (20,000 ft), and so far as proof goes, the powers of

toleration of low oxygen are less in man than in certain other mammals, for example, in mice, rats, and rabbits.

Of course, the climbers recovered on descending the mountain, as did the animals when the oxygen was increased. It was only by examining the tissues of dead and killed animals that the damage to their organs was detected. The damage was repaired in the surviving animals when these were put under normal oxygen pressure. If any man is similar to certain of the surviving mice and rabbits, he should be able to reach the top of Everest without the use of oxygen apparatus, and recover after the descent. The results of the expeditions certainly leave the question, whether he is similar, open. It is obvious, however, that the risk is great, and the degenerations detected in the animals' tissues indicate what that risk is.

Nicholls Wood,  
Chalfont St Peter,  
Bucks

LEONARD HILL.

<sup>1</sup> NATURE, 129, 244, Feb 13, 1932

### Fertility in Hybrids between New and Old World Cottons

THE first hybrid between Asiatic and New World cottons ( $n=13 \times n=26$ ) was recorded and described by Zaitzev<sup>1, 2, 3</sup>. The parentage of this cross was *Gossypium herbaceum* (female) by *G. hirsutum* (male), and the resulting plants were, without exception, completely sterile on both female and male sides. Other workers have since confirmed Zaitzev's results. Desai<sup>4</sup> obtained a single plant of similar parentage to that described by Zaitzev. This plant was also sterile. He states that the pollen was successfully used on both parents. More recently, Vycotski<sup>5</sup> again produced hybrids between *G. herbaceum* and *G. hirsutum* which were sterile when self-pollinated and when back-crossed to the parents. Nakatomi<sup>6</sup> reported a hybrid in which the New World type ( $n=26$ ) was used as female. He found complete sterility of the hybrid, which he ascribed to irregular chromosome behaviour in meiosis.

Since 1926 several thousand crosses between Asiatic and New World cottons have been made at this Station, using various races of each both as female and male. Using Asiatics as female met with no success. Apparently sound seeds were often obtained, but these contained only minute, shrivelled embryos. Using New World as female, two hybrids were produced, and one of these, *G. barbadense*, L.  $\times$  *G. arboreum*, var. *sanguinea*, although sterile on the female side, has proved to possess some functional pollen grains, since it will cross with *G. barbadense*.

A detailed account of this interesting hybrid will be presented at a later date, and it will be sufficient to refer to a few important features.

|                 |                   |                                                                                    |
|-----------------|-------------------|------------------------------------------------------------------------------------|
| Flower Colour   | <i>sanguinea</i>  | Red, with a large and intense petal spot                                           |
|                 | <i>barbadense</i> | Yellow, with a less intense petal spot                                             |
|                 | $F_1$             | Yellow, with a red flush at the petal edges. Spot intermediate between the parents |
| Colour of Plant |                   |                                                                                    |
|                 | Body              |                                                                                    |
|                 | <i>sanguinea</i>  | Leaves red                                                                         |
|                 | <i>barbadense</i> | Leaves green                                                                       |
|                 | $F_1$             | Leaves red, but intensity reduced                                                  |

In inter-Asiatic crosses, the complex red leaf, red flower, intense petal spot is inherited as a single unit character.  $F_1$  plants exhibit reduction of anthocyanin

in the flower with certain combinations of factors, but in the *barbadense-arboreum* hybrid there is a much greater reduction of colour in the flower

In respect of other characters the  $F_1$  was intermediate, sometimes approaching one of the parents, sometimes the other

**Back-cross,  $G$  barbadense  $\times$  ( $G$  barbadense  $\times$   $G$  arboreum)**—Back-crosses were successfully made to various types of *G barbadense*. Usually only one seed per boll was obtained, and many of these either failed to germinate or gave rise to weak and abnormal seedlings which died in a few days. Ultimately eight healthy plants were raised to maturity

Of the eight plants, five showed the red-leaved character of *arboreum*, with a varying amount of red in the flower. This indicates that an Asiatic chromosome, or that part of it containing the red factor ( $R$ ), was carried by some pollen grains. A considerable weakening of the effect of the  $R$  factor was found in some of the plants. In one plant ( $F_1 \times$  barbadense, with faint petal spot) the red colour of the flower almost disappeared and the spot was considerably weakened. This suggests that the compound character, red plant body, red flower, intense petal spot, is the result of a basal gene  $R$ , for red plant body, acted upon by modifiers to produce a further development of colour in the flower

Back-crossing with a New World type results in the Asiatic modifiers being eliminated or replaced by New World factors, since if the Asiatic modifiers had been represented in *S barbadense* there would have been no reduction in flower colour or spot intensity. It is further evident that the  $R$  modifiers must be present in an almost homozygous condition throughout the Asiatic cottons, since they exhibit little or no segregation in inter-Asiatic crosses

The eight back-cross plants were again back-crossed with *G barbadense* of various types in both directions. Three plants proved to be fertile on both female and male sides, and several seedlings from the second back-cross are now being studied. The great increase in fertility of the plants in the first back-cross suggests that one or more Asiatic chromosomes may be capable of functioning in a New World plant body. If this surmise is correct, the way is opened towards the synthesis of new types of cotton combining the desirable economic characters of the New and Old World groups of cottons. The cytology of these hybrids is being investigated by Dr A Skovsted at this Station. S C HARLAND

Genetics Department,  
Cotton Research Station, Trinidad, Jan 14

<sup>1</sup> *Agr J Ind*, 20, p 213

<sup>2</sup> *Agr J Ind*, 21, p 460

<sup>3</sup> *Agr J Ind*, 22, p 155

<sup>4</sup> *Agr J Ind*, 22, p 351

<sup>5</sup> *Bull Sci Res Cott Inst*, Tashk, 1, p 26

<sup>6</sup> *Jap J Bot*, 5, p 371

### Spectrum of Bismuth Hydride

SOME time ago <sup>1</sup> we reported a band system  $1\Sigma^* \rightarrow 1\Sigma$  in bismuth hydride, having its origin in the vicinity of the Bi line  $\lambda 4722$ . With the aid of improved light sources, we have been able to trace this system more completely, the bands (0, 0), (0, 1), (1, 0), (1, 1), (1, 2) being analysed at high dispersion. In addition, two new band systems are now reported. In the red part of the spectrum a  $1\Sigma^* \rightarrow 1\Pi$  system appears, having a common initial state with that of the blue system. The bands here analysed are the (0, 0), (0, 1), (1, 0), (1, 2) states of vibrations

This band system is specially interesting as showing indications of a hyperfine structure due to the high nuclear spin in the bismuth atom <sup>2</sup>. Further, we observed two faint and sporadic bands at  $\lambda\lambda 4840, 5170$ ,

belonging to a new  $1\Sigma^* \rightarrow 1\Sigma$  transition, not combining with the states mentioned above. Both bands have a common initial state, very unstable as indicated by its large  $r_0$ -value and by the abrupt cut-off in the intensity of lines above  $K=5$ . Temporarily we assign this level to  $v'=0$  and the final levels to  $v''=0, 1$ . Later on we intend to make a study of the pressure effect in these bands, which bear a strong likeness to the well-known C-band in the spectrum of calcium hydride <sup>3</sup>.

Some data on the electronic states discussed above are given below

|                | $T_e$    | $\omega_e$ | $\omega_e x$ | $B_e^*$ | $-D_e \cdot 10^5$ | $a$   | $r_0 \cdot 10^8$ |
|----------------|----------|------------|--------------|---------|-------------------|-------|------------------|
| $1\Sigma$      | 0        | 1656.93    | 21.23        | 5.063   | 18.35             | 0.147 | 1.819            |
| $1\Pi$         | 4936.58  | 1693.07    | 23.87        | 5.1775  | 20.0              | 0.155 | 1.802            |
| $1\Sigma^*$    | 21278.33 | ~1678      | ~17.5        | 5.214   | 20.05             | 0.189 | 1.792            |
| $1\Sigma_p(0)$ |          | $x$        |              | 4.31    |                   |       | 1.97             |
| $1\Sigma_p(1)$ | 1313.6   | $+x$       |              | 4.20    |                   |       |                  |
| $1\Sigma_x(0)$ | 20647    | $+x$       |              | 3.88    |                   |       | 2.09             |

For the lower  $1\Sigma$  and  $1\Pi$  levels the calculated energies of dissociation, expressed in  $\text{cm}^{-1}$ , are respectively 32,500 and 30,000, and consequently they may be derived from the same state in Bi. The corresponding value for  $1\Sigma^*$  is roughly estimated to 40,000  $\text{cm}^{-1}$ . As available levels in the doublet system of Bi, fitting into these limits, we have already suggested <sup>1</sup> the  $6s^2p^3 \ ^2D_1(-47323, -43304)$  and  $6s^2p^2 \ ^7s(-26153)$  levels

On the basis of Van Vleck's theory, a study of the  $\Lambda$ -doubling in  $1\Pi$  is likely to give more detailed information regarding the electronic configuration in bismuth hydride. Our observations give

$$\Delta_{ac}(v) = 0.020K(K+1) + (T_d > T_c),$$

which does not vary to any considerable extent with  $v$

Mulliken and Christy <sup>4</sup> have recently examined a great number of  $1\Pi$ ,  $2\Sigma$ , and  $2\Pi$  states, especially those belonging to the hydrides, and stated that they stand to each other in the relation called by Van Vleck 'pure precession'. The restated relation for  $q_0$ , the coefficient of the  $\Lambda$ -doubling in  $\Pi$ , given by these authors, is

$$q_0 = \frac{2B_v^* 1(1+1)}{v(11\Sigma)} \text{ where } B_v = B_v^* - q_0$$

Assuming the precession brought about by a  $p$ -electron ( $l=1$ ) and using the values in our table above, we get

$$q_0 = 0.021,$$

in fair agreement with the observed value above

Finally, we wish to express our gratitude to the Nobel Foundation, Stockholm, for the gift of high tension transformers, which enabled us to carry through the experimental part of this work

E HULTHÉN  
A HEIMER.

Laboratory of Physics,  
University of Stockholm, Jan 20

<sup>1</sup> A Heimer and E Hulthén, *NATURE*, 127, 557, 1931

<sup>2</sup> E Hulthén, *NATURE*, 129, 56, 1932. Note: The estimated effect of the molecular rotation on the line width  $\sim 0.02 \text{ \AA}$  mentioned in this paper should be read  $\sim 0.002 \text{ \AA}$

<sup>3</sup> B Grundstrom and E Hulthén, *NATURE*, 125, 634, 1930

<sup>4</sup> R S Mulliken and A Christy, *Phys Rev*, 38, 87, 1931

### Nuclear Spin and Hyperfine Structure in Band Spectra

PROF E HULTHÉN <sup>1</sup> has attempted to show that the splitting of mercury hydride ( $\text{HgH}$ ) band lines into four components, as was found by me <sup>2</sup> in the (0, 0), (0, 1), (0, 2) and (0, 3) bands and by R Rydberg <sup>3</sup> in the (2, 1) and (3, 2) bands of the  $2\Pi_1 \rightarrow 2\Sigma$  electronic transition, is a normal isotope effect caused by the difference of masses between the isotopes of mercury. The failure to explain the observed line structure by the usual isotope formula he interprets

as indicating the inapplicability of this formula to a mercury hydride molecule, which forms a unique example of an unstable molecule in the  $^2\Sigma$  state Prof Hulthén further states that the isotope splittings calculated with the aid of Birge's formula (concerning the vibrational effect) show sufficient agreement with my data, and that there is no need to search for another explanation based on consideration of the magnetic and electric constitution of the nuclei

However unexpected may be the observed approximate constancy (to twenty per cent) of  $\Delta\nu$  in the wide interval of the band (0, 0) from  $\Delta\nu_{\text{rot}} = 446$  to  $\Delta\nu_{\text{rot}} = 986 \text{ cm}^{-1}$ , with regard to the prevailing influence of the rotational isotope effect in this band, nevertheless, taking in account the conformity of Prof Hulthén's calculations with my experimental data, it may be admitted that the values of splitting

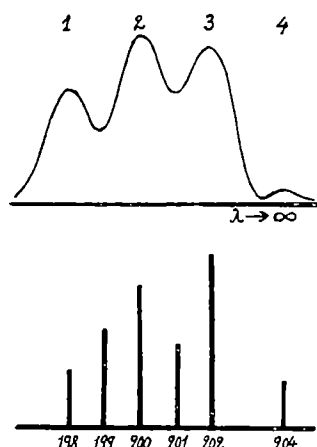


FIG 1

cannot be considered as a sufficient argument in favour of my suppositions. However, it gives another argument for my assumptions not examined in my former paper,<sup>2</sup> namely, the distribution of intensity in a group of components forming a line of the band. This distribution is shown qualitatively in Fig 1 (upper diagram), where we have a curve analogous to the curves obtained with the aid of a self-recording Moll microphotometer for various lines of the mercury hydride bands. In the lower diagram is given for comparison the percentage abundance of mercury isotopes found by Aston<sup>4</sup> in his accurate measurements. The discrepancies of the two diagrams are very evident, especially if it is remembered that the strong triplet found by me was very well resolved in the region of the (0, 0) band, the resolution increasing toward the larger frequencies. It is not clear why the first component of the quadruplet appears well resolved, while with the resolving power used it ought to merge with the 199- and 200-isotopes components into a diffuse band of asymmetrical character.

The same difficulty exists concerning the results of R. Rydberg's investigations,<sup>3</sup> to which Prof Hulthén also refers. Rydberg worked with a spectrograph of a little lower resolving power than that of the Lummer-Gehrcke parallel plate used in my experiments, and has also resolved the lines of the (2, 1) and (3, 2) bands into four components, which he ascribes to the four even isotopes of mercury. On account of the relatively high percentage of the 199-isotope it appears difficult to make clear the appearance of the well-resolved 198-isotope component. It is worth noting that the amount of splitting measured by Rydberg is approximately equal to that found by me.

With regard to the above difficulties, I think that the problem can be resolved only by new investigations carried out with spectrographs of greater resolving power.

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<sup>1</sup> E. Hulthén, *NATURE*, 129, 56, 1932

<sup>2</sup> S. Mrozowski, *Z. Phys.*, 72, 776, 1931

<sup>3</sup> R. Rydberg, *Z. Phys.*, 73, 74, 1931

<sup>4</sup> F. W. Aston, *Proc. Roy. Soc. A*, 126, 511, 1930

### Periodic Precipitation Structures

RECENT correspondence<sup>1</sup> has indicated that it is possible to explain the formation of periodic precipitation structures without invoking the aid of colloid-chemical principles. The amount of work which has been done on this subject is probably greater than even those who have made valuable contributions are aware. During the past ten years I have been collecting a bibliography, and I have recently had the assistance of the Science Library, South Kensington, through the kindness of Dr S. C. Bradford. My collection now contains almost five hundred references. The investigations include not only periodic structures formed by chemical double decomposition, both with and without the presence of colloids, but also those produced by salting-out, coagulation, crystallisation (from melts and from solutions), condensation, evaporation, desiccation, and sedimentation.

It may be argued that these are different phenomena, having a merely outward resemblance. Nevertheless, it is possible to explain even the most diverse types of periodic structure, assuming two conditions: (a) a critical condition for precipitation, crystallisation, or other change (supersaturation, undercooling, and a threshold concentration for coagulation are included in these conditions), (b) mobilisation of one or more of the substances (including diffusion, adsorption, capillary attraction, etc.).

It is not possible to discuss this general theory further in the space at my disposal here, but it will shortly be published in my book, "Liesegang Rings and Other Periodic Structures" (Chapman and Hall, in the press), where it is shown that in its application to the Liesegang phenomenon the theory includes those of W. Ostwald, Bradford, Dhar and Chatterji, and W. Ostwald.

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<sup>1</sup> McBain, *NATURE*, Dec 19, 1931, Friend and Vallance, *ibid.*, Feb 6, 1932.

UNLESS qualified, the views of Prof J. W. McBain,<sup>1</sup> as well as those of Drs Friend and Vallance,<sup>2</sup> are apt to convey a wrong impression. Is the colloidal state *always* not essential in periodic precipitations? Is any particular state or phase essential to these formations?

Although the electrolytic, dilution, rapid cooling, and hydroxy-organic methods make it increasingly more difficult to indicate a clear demarcation line between transient colloids and non-colloids, still a general survey of the vast number of periodic precipitations affords us cases where the colloidal state is not only absent, or not essential, but also where it is the determining factor.

The co-ordination of recent work<sup>3</sup> on periodic precipitations such as Kundt's figures and change of phase with or without chemical interaction (condensation, coagulation, salting out, evaporation, etc.) reveals the following significant facts:

1. Periodic precipitations are in general not confined to physical or chemical phenomena only, and are not restricted to any specific state or phase of matter or to any definite number of components.

2. Periodic precipitations are the material record of an undulatory movement in a mobile magma. This movement characterises generally the relationship of matter and energy, and is expressible in terms of wave mechanics.

3. As a record of change or transition, periodic precipitations are determined by the relation existing between the frequency-amplitude of undulation and

the boundaries of the system. Reducing the former, we can maintain a relationship adequate to periodic precipitation only by a corresponding reduction in the diameter of the boundary system, thus, in the case of slow movements, periodic precipitations are restricted to narrow tubes, capillaries, and ultimately large surfaces afforded by colloids.

The maxima and minima involved in this relationship find expression in practically all theories of periodic precipitation under such terms as nodes and antinodes, critical points, compression and rarefaction, under- and super-saturation, etc.

In considering the problem of periodic precipitations, we must bear in mind, however, the fact that whilst the fundamental principles of periodicity and its material records are not confined to any state or phase, the actual type and complexity of each periodic precipitation is determined by all the properties of the particular phase of matter involved in the phenomenon. This is specially the case with the colloidal state capable of functioning as either a system's boundary, medium, or component, or even all these rolled together, thus evolving the biological and mineralogical periodic structures in all their ramifications.

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<sup>1</sup> NATURE 128, 1042, Dec 19, 1931

<sup>2</sup> NATURE, 129, 205 Feb 6, 1932

<sup>3</sup> Copisarow, *Koll Z*, 54, 257, 1931 *Chem News*, 143, 341 1931  
*J Phys Chem*, 36, 752, 1932

AFTER placing a drop of oil on a smoked glass and observing the system about an hour later, a new observation of periodic structure has been discovered.

The smoked glass under observation carried a continuous carbon film of particles about 0.2 micron in diameter, and the oil drop in slowly spreading caused the previously regular and continuous carbon film to become rearranged into alternately opaque and clear concentric rings or zones underneath the spreading drop. The effect was readily repeatable with other oil drops and smoked slides.

In every case so far observed, the central zone is a dark one, followed by a comparatively narrow, concentric, clear zone. In general, so far as trials yet go, the alternate zones are repeated several times in one experiment.

Whilst the phenomenon at once brings to mind the analogous chemical instance of periodic precipitation, it would seem to be purely physical. Oils of varying viscosity may be used, and the effect is best observed if, after carefully posing one drop of oil on the film, the glass is set down in a perfectly horizontal position. After, say, twenty-four hours, the spread oil film may be removed with carbon tetrachloride without destroying the ring structure formed in the carbon film.

Whilst, in addition to normal periodic precipitation, J W McBan<sup>1</sup> quotes work showing that periodic precipitation can occur in the absence of colloids, and E S Hedges<sup>2</sup> records the production of sodium chloride periodic structures without chemical action by salting out from solution, this is a case where periodic structures are formed in the absence of colloids, chemical action, and dissolution. Experiments and observations will be continued.

S C BLACKTIN

1 Adelaide Road,  
Andover, Hants, Feb 18

<sup>1</sup> NATURE, 128, 1042, Dec 19, 1931

<sup>2</sup> NATURE, 128, 401, Sept 5, 1931

No 3254, VOL 129]

### Rate of Ionisation of the Atmosphere

THE calculation of the rate of ionisation of the atmosphere on the basis of the well-known Schweidler recombination law, by G R Wait<sup>1</sup> and J J and P J Nolan,<sup>2</sup> has shown a large variation in the rate, in the course of the day, at observing stations in Washington, D C, in the United States, and near Dublin, Ireland. It is of interest to note that the maxima of the diurnal variation curves for these stations agree closely when plotted on Greenwich Mean Time.

The Department of Terrestrial Magnetism, in connexion with its programme of study of atmospheric pollution in relation to ionisation and other atmospheric electric phenomena, has constructed, and installed on the laboratory grounds at Washington, D C, an apparatus for measuring simultaneously the small ion and large ion content from the same sample of air.

Results obtained with this apparatus permit the calculation of  $q$ , the rate of ionisation, with greater accuracy than was possible by the method employed in the previous work by Wait, in which values of nuclei content, obtained on the observatory grounds, were utilised together with values of small ion content computed from conductivity records obtained on the observatory roof. Values of  $q$  were obtained for three sets of observations in the free atmosphere on successive days in November 1931. All three days show a maximum value at approximately the same time as that previously found by Wait, as may be seen from the following table.

| Values of $q$ on 75° Mean Time |     |     |        |     |     |        |     |     |
|--------------------------------|-----|-----|--------|-----|-----|--------|-----|-----|
| Nov 23                         |     |     | Nov 24 |     |     | Nov 25 |     |     |
| hr                             | min | $q$ | hr     | min | $q$ | hr     | min | $q$ |
|                                |     |     |        |     |     | 9      | 37  | 2.0 |
|                                |     |     | 10     | 00  | 2.1 | 9      | 59  | 3.0 |
|                                |     |     | 10     | 30  | 2.9 | 10     | 22  | 2.7 |
| 10                             | 54  | 3.2 | 10     | 47  | 3.2 | 10     | 46  | 2.4 |
|                                |     |     | 11     | 05  | 2.6 | 11     | 08  | 3.6 |
| 11                             | 18  | 4.0 | 11     | 27  | 4.3 | 11     | 29  | 6.0 |
| 11                             | 46  | 2.9 | 11     | 49  | 6.4 | 11     | 49  | 3.4 |
| 12                             | 09  | 2.7 | 12     | 08  | 5.7 | 12     | 11  | 2.9 |
|                                |     |     | 12     | 26  | 5.1 |        |     |     |
| 13                             | 35  | 1.8 | 13     | 32  | 3.3 | 13     | 46  | 1.8 |
| 14                             | 00  | 1.6 | 14     | 01  | 1.2 | 14     | 11  | 1.7 |
| 14                             | 25  | 1.8 |        |     |     | 14     | 30  | 1.7 |
|                                |     |     |        |     |     | 14     | 49  | 2.0 |
|                                |     |     | 15     | 04  | 1.3 | 15     | 11  | 1.5 |
| 15                             | 28  | 1.5 | 15     | 26  | 2.5 | 15     | 34  | 1.8 |
| 15                             | 49  | 1.5 | 15     | 46  | 2.0 | 15     | 53  | 1.6 |
| 16                             | 09  | 1.6 | 16     | 07  | 3.2 | 16     | 14  | 1.5 |

The maxima in this table are about two to three times as large as the average value of  $q$ , and, furthermore, all values, including the maxima, are lower than that which is usually accepted as normal ( $q$  about 10) for most localities. Similar results were obtained by J J and P J Nolan, according to the publication already cited. It is worthy of note that, by using their modified form of the Schweidler equation on the data here discussed, the values of  $q$  are trebled and are thus brought to what appear to be more reasonable magnitudes.

Possible explanations for the variations in  $q$  have been considered. Barometric records have been examined but no correlation has been found between variations in atmospheric pressure and variations in  $q$ . Furthermore, the maximum in  $q$  is associated on only one day with a maximum in nuclei content, on the other two days it is associated with maxima in small ion content. This would indicate that the maximum in  $q$  cannot be explained by the assumption

that radioactive carriers suspended in the atmosphere become attached to nuclei and so cause increased ionisation with increase in nuclei

Finally, some consideration has been given to the possibility that the variation in  $q$  appears only because the presence and behaviour of intermediate ions have not been taken into account. Perhaps intermediate ions are present which become least numerous as the large ions become most numerous, and, further, these intermediate ions may have a much larger recombination coefficient with the small ions than have the large ions. While no data have as yet been obtained to define the part played by intermediate ions of mobility greater than 0.004 cm/sec/volt/cm, some observations have been made on intermediate ions with smaller mobilities. The results indicate that ions of this type do not vary in number in such a manner as would, if given separate consideration, produce a more constant value of  $q$  than has been shown above.

G. R. WAIT  
O. W. TORRESON

Department of Terrestrial Magnetism,  
Carnegie Institution of Washington,  
Washington, D. C.,  
Jan 13

<sup>1</sup> *Terr. Mag.*, 36, 111-131, 1931

<sup>2</sup> *Proc. Roy. Irish Acad.*, A, 40, 11-59, 1931

### The Highest Atomic Number

It has been suggested (I believe by Sommerfeld) that the highest possible atomic number is the constant  $hc/2\pi e^2 = 137$ . According to Eddington's theory, this number represents the number of degrees of freedom of a system of two charges. It is natural to suppose that there is a correspondence (direct or indirect) between degrees of freedom and independent wave-functions, so that the maximum number of independent wave-functions for a nucleus and satellite electron is 137. By the exclusion principle each satellite electron must be provided with an independent wave-function, so that there cannot be more than 137 of them.

In Eddington's analysis, 136 of the degrees of freedom are relativity rotations associated with the symmetrical matrix expressions  $E_a E'_b + E_b E'_a$ , where  $a$  and  $b$  have values from 1 to 16. The generalised interaction energy is  $\sum_{a=1}^{16} E_a E'_a / 137r$ , where  $r$  is the invariant proper distance of the two charges, although the portion  $\sum_{a=1}^{16} E_a E'_a / 137r$ , turns out to be of special significance in a four-dimensional space. Also, the general matrix expression associated with the interchangeability of charges is  $\sum_{a=1}^{16} E_a E'_a$ . I have found that this last expression is invariant only for 91 out of the 136 rotations, it is altered by the 45 rotations for which  $E_a, E_b$  commute and are not equal to each other or to  $E_{16} (=i)$ . Having regard to the association of wave-functions with constant energy, it is perhaps permissible to assume that wave-functions are generated only by the 91 rotations which leave the energy invariant.

If this is right, it follows that the highest possible atomic number is  $91 + 1$  instead of  $136 + 1$ , so that there can be no element beyond uranium (92).

V. V. NARLIKER

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Cambridge,  
Feb 26

No 3254, Vol 129]

### Possible Existence of a Neutron

In a paper to appear shortly in the *Proceedings of the Royal Society*, I have reported observations on the absorption of the radiations produced in beryllium and other light elements by bombardment with polonium  $\alpha$ -particles. The experiments indicated that the radiations emitted from beryllium, boron, and fluorine in the 'forward' direction, that is, in roughly the same directions as the  $\alpha$ -particles producing them, were less absorbable than those emitted in the backward direction. In my paper I show that this observation is very difficult to reconcile with conservation of momentum and energy if the radiations are assumed to be  $\gamma$ -radiations corresponding to the energy available.

Now that Dr Chadwick has put forward evidence for the existence of neutrons,<sup>1</sup> this difficulty appears to be solved. Thus if the radiations are assumed to consist of neutrons, it follows immediately from the conservation laws that those emitted in the forward direction must have considerably more energy (50 per cent in the case of beryllium) than those emitted in the backward direction. This suggests that the radiations from boron and fluorine, as well as that from beryllium, consist at least in part of neutrons.

H. C. WEBSTER

H. H. Wills Physical Laboratory,  
The University, Bristol,  
March 2

<sup>1</sup> NATURE, 129, 312, Feb 27, 1932

### Protection of Herbarium Specimens

In making a herbarium collection of Indian types of cotton, the necessity was felt of protecting the mounted specimens from injury while handling. To meet this difficulty, the senior writer suggested using a transparent celluloid material as a covering for the specimens. 'Cellophane', 'Cellglass', 'Sidak', and other trade names are applied to such products, which are sold in sheets, and are very thin, tough, flexible, transparent, damp-proof, and inexpensive. In commerce, these materials are used for wrapping boxes of chocolates, etc.

The universal practice of mounting pressed and dried plants without protective covering has the serious disadvantage that the leaves and flowers become brittle and are liable to break off. Thus, if the specimens are constantly being examined, these losses ultimately deprive the collection of its scientific value. The celluloid tissue used, while protecting the specimens from injury and breakage, at the same time allows the observer to examine the specimens with ease, even with a lens.

The technique employed is very simple. After the specimens have been pressed and dried, they are fastened to the mounting paper with a celluloid-base cement, such as 'Durofix', an improvement which does away with the necessity of stitching or using strips of paper to keep the specimens in position. A sheet of tissue is then cut to the required size, the edges are smeared very thinly with celluloid cement, and the sheet is then laid over the specimens on the mount, to which it adheres readily.

An additional advantage is that if the celluloid tissue has been carefully applied, the risk of damage by insects is reduced.

F. K. JACKSON  
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## Research Items

**The Jinn in Eastern Folklore**—In the course of some notes on Arabian and Persian folklore in *Folk-Lore*, vol 41, no 4, Prof R A Nicholson points out that old Arabian pre-Islamic folklore has a character all its own, and that, notwithstanding the belief in jinn, the supernatural played a very small part in the life of the sixth-century Beduin. Belief in the jinn was made an article of faith by Mohammed, and his authority is cited for the statement that every Muslim at his birth and throughout his life is attended by a jinni or familiar spirit. Though normally invisible, they can assume any shape they please, yet so long as a spiritual being is looked upon by the human eye it cannot change its form—a belief which appears also in Irish folklore. The Muslim jinni, however, can evade the difficulty by producing a form before itself like a screen. When this is moved the eye follows it involuntarily and the jinni escapes. The jinn have much in common with our fairies. In Persia, a rite known as "The Feast for the Daughter of the Fairy King" is employed to propitiate the fairies whose wrath has been aroused, especially when this is manifested by a visitation of sickness or misfortune. Priestesses, old women acquainted with the rite, alone are allowed to perform it. A mirror, chafing dish, cup of water, some sugar-cane, collyrium, frankincense, and the egg of a black hen are carried to the top of a hill or other suitable spot which previously has been swept clean. A fire is lighted, into which seeds of rue are thrown, and incantations are chanted. At night the sick person is brought to the spot, or, if he is too ill, the objects named are carried to his bedside in a wallet. He must eat some of the sugar-cane, apply the collyrium to his eyes, and then look at his miserable face in the mirror, while he listens to the auguries which the old woman draws from the appearance of the yolk of the egg. Usually the verdict is that an entertainment must be given to the daughter of the Fairy King, so that, eating salt with the man, she may pardon his offence.

**Teleilat Ghassul**—An account of excavations carried out by Père Mallon of the Biblical Pontifical Institute, Jerusalem, in 1929-30 and 1930-31 at Teleilat Ghassul, is given by the Rev J G Duncan in *Ancient Egypt*, 1931, pt 3. The site lies about six kilometres north of the Dead Sea and about four kilometres east of Jordan, almost in the centre of the plain Arboth Moab. The number of the tells in the neighbourhood argues that the population in the copper and bronze ages was considerably more dense than it is nowadays. Of these tells, Teleilat Ghassul is one of the most ancient. The natural soil, reached at a depth of about 18 ft, is sand, an ancient sea floor. The whole ruin, including suburbs on the southern side, is 800 metres by 400 metres in extent. Four strata of occupation were found, the suburbs belonging to the latest and largest. Each city was destroyed by fire, as is demonstrated by the deposit of ashes which overlies each floor. The pottery falls into two or three classes, neolithic, and copper and bronze age, pointing to an occupation lasting from about 2500 B C to 1900-1800 B C. After the destruction of town IV by fire, the site was not re-occupied. Prof Petrie has pointed out that bronze may appear in Palestine at a date earlier than that implied by Père Mallon, which might give a date for the destruction of the town at 2100 to 2000 B C. This would strengthen Père Mallon's identification of the southern mound with Sodom. A remarkable feature of the site is the large number of inscribed stones and seals, sherds and brick which have been found. These

have not yet been deciphered, but they support the conclusion, reached on other grounds, that from the earliest to the latest settlement, notwithstanding the marks of development and transition, the same civilisation prevails. This also holds of the northern mound, which, tentatively, is identified with Gomorrah.

**Sexual Behaviour in Frogs and Toads**—In certain of the tailed amphibians it has been recognised that the chief rôle in sex recognition is played by chemical sense, but as regards the frogs, opinion has been by no means sure. Now Ch'eng-Chao Liu has made a study of the Siberian toad (*Bufo raddei*) and the pond frog (*Rana nigromaculata*), both natives of north-eastern Asia, and the result is his rejection of the chemical sense as the basis of sex recognition in these species (*Peking Nat Hist Bull*, 1931-32, vol 6, p 43). In this he confirms the observations of Noble and Farris on the American wood-frog. The author finds, regarding the frog and toad, that males appear first during the breeding season, and females ready for egg-laying are attracted by the calling croak of the males. The males appear to mate indiscriminately with whatever individual they come across, but should that happen to be a male, a new note, a croak of warning, is sounded by the lower male and this, sometimes combined with repulsive action, leads to sex recognition. When the eggs have been laid, the females escape by elongating their bodies, and thereafter they move to the land. The persistence of the male embrace is matter for wonder—on several occasions the bodies of dead males and females were offered to normal males, often the males clasped the dead bodies, and sometimes they retained their hold until the grasped bodies began to decay.

***Spirula* from the Dana Expeditions**—Prof Graham Kerr has given us a very beautiful and intensely interesting account in his "Notes upon the *Dana* Specimens of *Spirula* and upon Certain Problems of Cephalopod Morphology" (Oceanographical Reports edited by the "Dana" Committee No 8, Copenhagen). The *Dana* was fortunate in obtaining ninety-five specimens of *Spirula* in the Atlantic Ocean between 10° and 35° N lat, most of the catches being in the west Atlantic, whilst others occurred in the eastern Atlantic from the Canaries to north of the Cape Verde Islands. The live specimens have already been described by Prof Schmidt (*NATURE*, Dec 9 1922). In the orientation of the body the cephalopodium theory is definitely abandoned, and the head is regarded as anterior, the tip of the body posterior, the funnel surface ventral, and the surface opposite to the funnel dorsal. *Spirula* is in no sense a primitive form and it should be placed high up in the scale of cephalopod evolution. It is argued that the primitive cephalopod shell was spiral and not straight, and the shells of Cephalopoda—living or extinct—in which the nautiloid spiral is departed from are necessarily internal. The spherical initial chamber of *Spirula* is taken as indicating that at no stage in its life history is it external. The straightening out of the shell in its later formed portion is important as showing the beginning of progressive evolution towards a loss of the spiral, and its endogastric curve is interpreted as due to its having undergone rotation within the body. There is torsion of the posterior loop of the alimentary canal, which is believed to be a result of the rotation of the shell within the body during the phylogenetic history of *Spirula*. The radula is shown to be non-existent, the supposed radula teeth being tooth-like projections of the buccal lobes. The coelom and the male

genital organs are described in detail, the renal sacs being fused together as in other dibranchs. The whole work is full of important information and carefully thought out deductions.

**The Effects of Fixatives**—The principal conclusions of A. A. Tarkhan (*J. Roy. Mic. Soc.*, Dec 1931) on the effects of fixatives and other reagents on cell-size and tissue-bulk are as follows. Exposure of fresh organs and tissues to air produces shrinkage, hence they should be placed in the fixative as soon as excised. Formol (5-10 per cent formaldehyde) over periods of 24-48 hours does not swell tissues, but the use of formol for longer periods should be avoided on account of the toughening of the tissues and consequent difficulty in sectioning. Mercuric chloride and picric acid, in saturated aqueous solutions, are powerful shrinking agents, as is absolute alcohol. Strong solutions of chromic acid (1 per cent) and potassium bichromate (4 per cent) are similar in effect. Clearing produces slow and progressive shrinkage, and this appears to be largely independent of the fixative originally employed. Xylol and toluol shrink tissues more than benzol, and oil of cedar wood (as is generally accepted) produces the least shrinkage. Embedding in paraffin should be reduced to the shortest time consistent with penetration, for it causes progressive shrinkage which is largely in direct proportion to the temperature.

**Volume Tables for Timber of *Acacia Catechu***—The utilisation of khair (*Acacia Catechu*) trees for the production of katha (which, mixed with betel and lime, forms the *pan* so commonly chewed by Indians), in the United Provinces of India, is effected by three different agencies. The general principle consists of reducing the black heartwood of the tree to chips and then boiling the latter. The three agencies are (1) the Chais—a special class of skilled katha workers from Gond and Bahraich districts who carry out their conversion of the timber in furnaces constructed near their camps situated on streams in the forest, (2) factories—the Indian Wood Products Company, with its factory at Izatnagar, has an agreement with the Forest Department for the supply of khair from the submountain forest divisions, its conversion is closer than that of the Chais, (3) the Paharis or hill-men—their method is wasteful, as they utilise only the best parts of the heartwood, leaving the rest to rot in the forest. In vol 13, pt 9 (1929), of the *Indian Forest Records* the first volume tables were prepared for commercial timber (katha) and heartwood for khair (*Acacia Catechu*) by members of the Forest Research Institute. These tables chiefly referred to areas worked by the Chais both in the United Provinces and in Bengal. In a recent part of the *Records* (vol 15, pt 3, 1931), H. G. Champion and Ishwar Das Mahendru supplement the former work by tables for factory working. A more regular method of working, and a more detailed knowledge on the subject of the volume likely to be procurable from definite areas, became necessary when a factory depended for its continued existence upon a constant supply of raw material. In view of the considerable range in value of trees of different sizes, volume data were desirable, and the investigations comprised in these two parts of the *Records* are of very considerable practical value.

**The Izu (Japan) Earthquake of Nov 26, 1930**—Since the earthquake, a line of precise levellings has been carried round the Idu peninsula, in the northern part of the route crossing the Tanna fault. This series has lately been compared by Prof. C. Tsuboi (*Earthq. Res. Inst. Bull.*, vol 9, pp 271-290, 1931)

with that made towards the close of 1923, and the latter with a series made in 1903. It is assumed that the changes between the first and second series were due to the Kwanto earthquake of 1923, and those between the second and third to the Idu earthquake. During the latter earthquake, displacements occurred over 18.5 miles of the north-south Tanna fault. The crust on the west side of the fault, relatively to the other, was shifted about 3 ft 3 in. to the south. The vertical movement was less simple, the western block being depressed relatively at the northern end and elevated at the southern (*NATURE*, vol 128, p 551). The line of levellings across the fault shows a V-shaped depression of 7.75 in. along the fault during the Idu earthquake, but very little change during the Kwanto earthquake. Along the western side of the peninsula, Prof. Tsuboi distinguishes six land-blocks, each of which moved separately during the earthquake, but with some order in their general displacement, for the directions of their tilts, beginning with the southern block, changed in a clockwise direction. This shows that the crust as a whole was twisted like a plate, and this is also indicated by the hinge-like vertical movement along the Tanna fault.

**X-Ray Wave-Lengths**—Accurate measurements of X-ray wave-lengths are usually made with crystals or ruled gratings, and a small but important difference exists between the results. An account of an application of a third method is given by J. A. Bearden in the first January number of the *Physical Review*. He photographs the refraction spectra produced when the X-rays are dispersed by a quartz prism with an angle of 90°, obtaining remarkably precise records of the deviation, from which wave-lengths are calculated by the quantum theory of the effect. The results are almost identical with those obtained by the crystal method, but are definitely not in agreement with the ruled grating measurements. The conclusion is somewhat unexpected, as the results of different observers who have used ruled gratings appear satisfactory in most respects, and indicates a possible failure of the theory of diffraction at a ruled grating when applied to X-ray wave-lengths.

**Absorption of Hydrogen by Metals**—In various papers, recently published, Franzini has advanced the hypothesis that hydrogen which has been absorbed by metals exists therein in the dissolved and dissociated state. It seemed possible, therefore, that displacement of this hydrogen into the mass of the metal might be effected by the influence of an electric field, and such possibility has been realised in experiments made on palladium by Coehn and Specht. Further investigation of this question has now been carried out by Franzini (*Rend. Roy. Lombardy Institute*, vol 64, parts 11-15, 1931). Wires of nickel and iron, hydrogenated by being heated in an atmosphere of hydrogen, were employed, and the subsequent displacement of the hydrogen was determined by observing the variations in the electrical resistance of the metal caused thereby. With nickel, quantitative data were obtained, but with iron only qualitative evidence of the displacement of the hydrogen towards the extreme negative, when the electric field was established, was forthcoming. The increase in resistance following absorption of the hydrogen is probably due to the setting up of an e.m.f. arising by polarisation of the hydrogen protons with respect to the molecules or groups of molecules of the metal. The linking is ruptured by the electric field and the gas migrates into the metal.

**Transport Numbers**—According to the modern theory of strong electrolytes, the mobilities of the ions vary with concentration, and since this variation

is not relatively the same for all ions, but depends on the radii and valencies, the transport numbers of salts will vary with concentration. Jones and Bradshaw (*J. Amer. Chem. Soc.*, Jan.) show that a method of calculation previously applied by Jones and Dale in 1929 to barium chloride can be applied to lithium chloride, and they have determined the transport number at many different concentrations between 0.023 and 2.95 normal at 25°, finding values from 0.3272 to 0.2575 over this range. They show that the transport number  $t$  can be represented as a function of concentration  $c$  by an equation of the form  $t = [A/(1 + B\sqrt{c})] - 1$ , where  $A$  and  $B$  are constants, as was the case with barium chloride. They also recalculate the electromotive force measurements of MacInnes and Beatty with lithium chloride and show that these results can be expressed by a similar equation, the actual figures given by MacInnes and Beatty having been calculated by another, empirical, method. The activity coefficient of the ions of lithium chloride varies with the concentration according to an equation derived by Hückel. Jones and Bradshaw's paper is an important one in relation to the modern interpretation of transport numbers.

**Determination of Nitrogen in Yeast.**—It is well known to analysts that certain substances such as meat, urine, and milk, and especially those high in nitrogen, resist the oxidising action of sulphuric acid in the original Kjeldahl method for the determination of nitrogen, and that, consequently, low results are

obtained. Modifications of Kjeldahl's method have therefore been proposed, such as that of Gunning, in which the sample is digested with sulphates of potassium and copper, with or without potassium permanganate, and the Christiansen and Fulmer methods, where hydrogen peroxide is the oxidising agent. In certain cases these methods also give doubtful results, and yeast, especially if dried or pressed, is a particular offender in this respect. In connexion with his work on nitrogenous metabolism in yeast, R. S. W. Thorne (*J. Inst. Brewing*, **38**, 23; 1932) therefore found it necessary to run comparative tests by the various methods—the Dumas method, a somewhat laborious and difficult procedure, being taken as giving the true nitrogen content. The Kjeldahl-Gunning method gave the same results, though after a shorter period of digestion than Kjeldahl's original procedure, but the results showed that only 91.2-95.9 per cent of the total (Dumas) nitrogen present was determined, the actual magnitude of the error being influenced by the specific character of the yeast examined. The Christiansen and Fulmer method, however, gave 99.4-99.8 per cent of the true nitrogen, but only when the optimum quantity of hydrogen peroxide (30 c.c. of 50-volume solution for 0.5 gm. of yeast) was taken. A rather surprising feature of the work is the fact that ter Meulen's method, in which the sample is heated with a nickel catalyst in a current of hydrogen and the resulting ammonia absorbed in acid and titrated, also gave low results.

### Astronomical Topics

**Photographs Measuring the Intensity of Moonlight.**—Dr. Frederick Schembor, Vienna XI, Grillgasse 31, III/37 Austria, has sent a request that observers who possess film cameras should take pictures of the moon out of focus on the nights March 21-22 and March 22-23, that is, the nights immediately preceding and following the almost total eclipse of the moon; the eclipse occurs about 1 P.M. on March 22, and is, of course, invisible in Europe. The object is to compare the moon's illumination before and after eclipse, in order to see whether the lowering of temperature during the eclipse leaves any discernible effect some hours later. Dr. Schembor wishes a screen to be prepared with a central aperture of the same size as the object glass. The screen is to be placed close to the film, with the aperture central. The distance from lens to film is to be one-third of the focal length. Many exposures can be made on a single film, moving it sufficiently between exposures to prevent overlapping of images. Varying exposures may be given from 1/100 of a second to 1 second, but the length of each and their order must be carefully noted, also the Greenwich time (to seconds) of each exposure, with notes on the clearness of sky, the make of film and of objective, the focal length, and the distance from film to objective. The film is to be sent undeveloped to Dr. Schembor at the above address. The name, address, and longitude and latitude of the sender are also to be noted.

**Solar and Terrestrial Relationships.**—In June 1924 the International Research Council appointed a special committee to study the relation between solar and terrestrial phenomena. This committee has now published a third report of its activities, to which are attached numerous memoranda, written by members and other leading authorities, on various aspects of the subject. Several of these memoranda deal with the meaning and value of the daily character figures of various solar phenomena which have

been published during the last few years in quarterly bulletins by the International Astronomical Union. The methods employed, reasons for discrepancies between the character figures from different co-operating observatories, as well as suggestions for their improvement, are all discussed; and indications are given as to the ultimate value of results to be obtained from them. The memoranda are too many to enumerate in detail, but several that deal with changes in the ultra-violet solar radiation as related to various terrestrial phenomena (such as the amount of ozone in our atmosphere) are perhaps of special importance. The whole report affords evidence of the considerable amount of useful research accomplished by the committee since its formation, and supplies a condensed summary of the present state of knowledge in those subjects which fall within the scope of the committee.

**Mass of Neptune's Satellite.**—The recent investigation at Mount Wilson of the mass of this satellite has already been noted in this column. A paper by Prof. H. N. Russell (*Scient. Amer.*, Feb.) now gives fuller details of the research: it is illustrated by photographs of the satellites of Uranus and Neptune taken at the Yerkes Observatory. The delicacy of the research is brought home by the fact that careful allowance had to be made both for the shift in the earth's centre due to the attraction of the moon and the displacement arising from the earth's rotation. The most probable value of the mass is five times that of the moon, or  $1\frac{1}{3}$  that of Mercury (using Backlund's value for the latter, which is  $\frac{1}{3}$ th of the earth's mass) and  $\frac{1}{3}$  of that of Mars. Prof. Russell conjectures that its diameter may be 2500 miles. Unless it is larger than this, it must have a high density if the mass found is near the truth. He calls the satellite "nameless": the name *Triton*, suggested by the late Camille Flammarion, is very appropriate. It has already been accepted by many astronomers, and might well receive general recognition.



## University College, Exeter

## THE WASHINGTON SINGER LABORATORIES

THE Washington Singer laboratories at University College, Exeter, the erection of which was rendered possible by the munificence of Mr. W. Washington Singer, contain the departments of chemistry and physics, and form the first instalment of an extensive scheme of university buildings intended to be erected on the Streatham site—a magnificent setting, amid delightful surroundings, and commanding views of valley and hill unsurpassed in the country. The lay-out of the scheme is governed by the slope of the

There are three floors, the ground and first floors being devoted mainly to physics and the second to chemistry. Each floor is divided by a corridor 8 ft. wide, and in general the rooms are arranged in units, or multiples of units, in width 10 ft. between centres. On both sides of the corridors, most of the rooms are 20 ft. deep. The ferro-concrete floors have intermediate support on a double row of concrete pillars coinciding with the lines of the corridor walls, which are of brick,  $4\frac{1}{2}$  in. thick. Occupying a central position

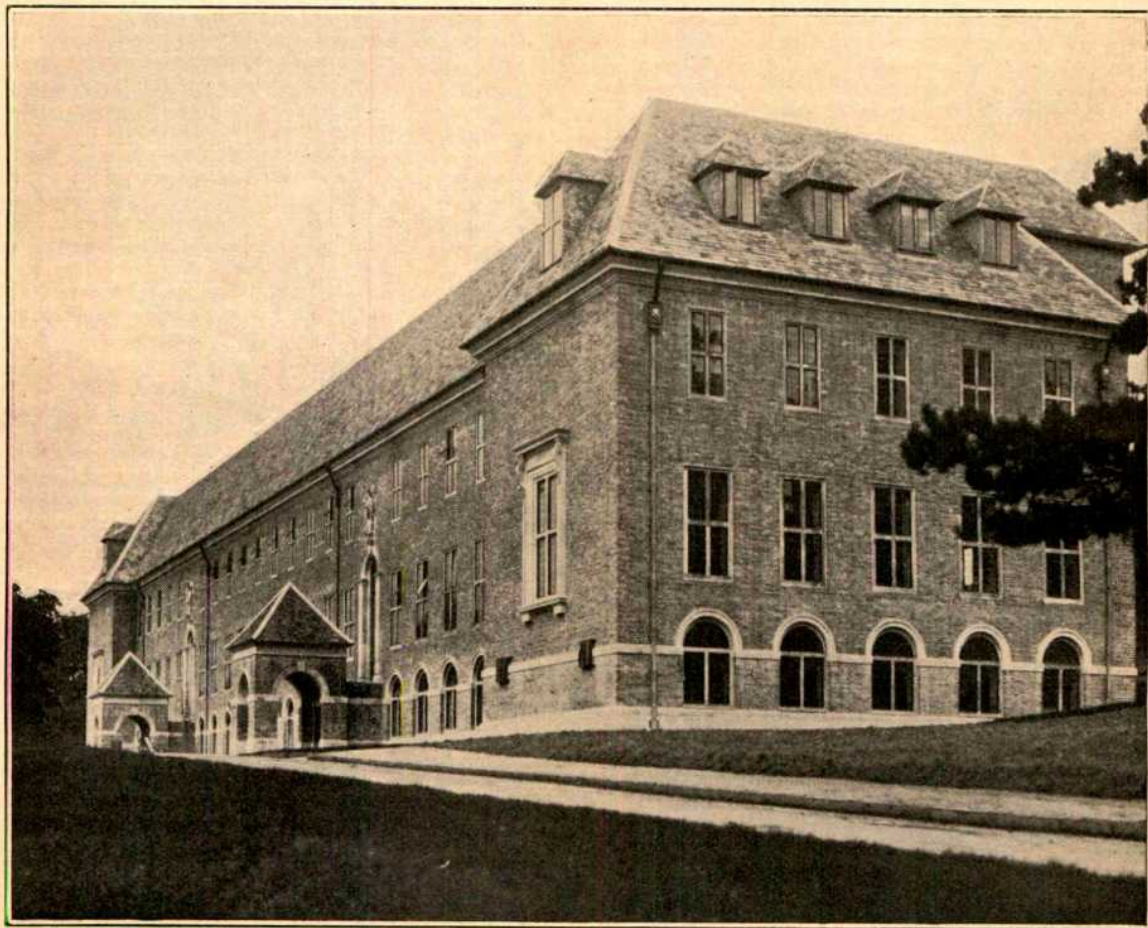


FIG. 1.—Washington Singer Laboratories, University College, Exeter.

site, the new laboratories facing almost due south. The front elevation, overlooking the Exe valley, is severely plain and bears nothing approaching the ornate, the only feature of a decorative nature being the coats-of-arms of the counties and principal boroughs in the region which the College serves. These take the form of unobtrusive mural tablets.

There are three main entrances to the building, which is approximately 300 ft. long and 55 ft. wide. It is faced with a fine brick of inconspicuous colour, and the long span of roof carries about 100,000 Cotswold stone tiles, forming a unique feature in the south-west. Like the facing bricks with which they tone, the tiles are less conspicuous than those commonly in use, and have a much longer life. A pleasing feature of the back elevation is the Tudor windows of Portland stone, which open upon a terrace.

is a large examination hall, about 100 ft. long and 35 ft. wide. It rises to the top of the first floor and will accommodate about five hundred students.

In the provision of gas, water, and electricity in the various rooms the floor-duct system has been adopted. Horizontal ducts are also provided in the first and second floors, which not only serve the purpose of a vitiated air duct in the ventilation system, but also give means for laying rapidly any temporary cable, or piping, as required, to any room.

The supply of direct electric current to the laboratories is obtained from a 250 ampere-hours battery of 110 volts, a 150-ampere 110-volt charging generator being also available for the distribution of heavy currents. The battery is subdivided at the fifth, fifteenth, twentieth, and thirtieth cells, and is intended for the supply of small currents at reasonably constant

voltages There is a substation on the ground floor, and the Corporation of Exeter supplies 210 volts two-phase alternating current, which is distributed for light and power In addition, there is a 200 volts direct current generator and an alternator, the latter supplying alternating current of variable voltage and frequency

For the supply of compressed air and of vacuum the unit system has been preferred to that of general distribution, and any worker who requires either of them has it thus under his own control The machines in the workshop are entirely unit driven, and there is a small furnace for casting An automatic domestic telephone service is installed in a number of rooms

The ground floor contains the workshop, battery and dynamo rooms, a small magnetic laboratory, two theatres, preparation and research rooms, a spectroscopy laboratory, and cloakrooms The larger theatre, which has seating for 150 as a minimum, is fitted with electrically controlled light-tight blinds, and the smaller theatre, which adjoins it, is provided with a minimum seating for 80 The acoustic properties of both theatres have received particular consideration, and the demonstration benches are anti-vibrational, being supported on a layer of concrete, 2 ft thick, embedded in the ground and separated from the floor The fixed slate benches in the spectroscopy laboratory and in some of the research rooms are also anti-vibrational

The first floor is similar in construction and contains a large laboratory for advanced students, intermediate and advanced optics rooms, honours laboratory, private, research, glass-work, apparatus, and store rooms, together with a large laboratory for intermediate students There is also a writing-room and a library, jointly used by the students of chemistry and

physics Except in the intermediate laboratory, there are no fixed benches on the floors, those around the walls being built on brick piers which rest on the concrete floor These wall benches are of solacite—an acid- and heat-resisting material similar to slate A special feature of the physics department is the provision of numerous electrical panels in all rooms, so that each student has available, on one and the same panel, lighting, power, and direct current (variable voltage) circuits This arrangement has already proved of the greatest value and convenience

The chemistry department occupies the whole of the second floor A feature is the junior laboratory—a spacious room about 80 ft long and 35 ft wide—for intermediate and pass degree students It has places for forty-eight students There are also laboratories for physical, analytical, and organic chemistry, two lecture theatres—similar to those on the ground floor—together with preparation and store rooms In addition, there is a number of small rooms which have been especially adapted for research

Flats above the second floor are provided for the caretaker and resident engineer, while a portion of the roof is flat and available for special experiments An automatic lift completes the equipment

Owing to the national situation, no official opening has been held, but last December the Physics Department, in conjunction with representatives of the electrical industry, organised a three-days' Faraday exhibition, at which Sir William Bragg gave the inaugural lecture This exhibition, which was attended by some five thousand people, enabled the general public to inspect the laboratories, the erection of which emphasises the rapid progress and development of the College, situated as it is in a non-industrial area

### Developments of Electric Lighting

IN the February number of the *G E C Journal* there is an interesting article by H W Richardson on the progress and development made by the General Electric Company in 1931 Considerable progress has been made in perfecting striated discharge tubes for lighting In all ordinary discharge tubes containing rare gases, the glow in the main part of the tube is continuous When, however, common gases such as air or nitrogen are used, the discharge, under certain conditions, breaks up into a number of separate sections This effect is known as the striated discharge Formerly it was only possible to get this effect momentarily As a result of recent work in the G E C laboratories, this type of discharge can now be produced at will in neon, and the effects are very striking and beautiful It is still in the experimental stage

In addition, new colours in cold cathode tubes such as are used for advertising purposes have been developed Hot cathode tubes, the intensity of the light from which is much greater than that of the older cold cathode type, have not yet reached the commercial stage, but development is proceeding very satisfactorily Owing to their high efficiency as sources of coloured light, they possess special attractions for use in coloured flood-lighting and for coloured lighting generally By suitable combinations of coloured sources, light for general illumination can be produced In combination with ordinary incandescent lamps they give light almost indistinguishable from daylight The absolute efficiency of the conversion of light into power is now very high The new so-called 'ripple' effect was described in the *Journal* two years ago At the time, this effect could only be obtained in blue or green colours It has now

been possible to produce it in neon gas so as to give the well-known orange hue

The G E C laboratories have carried out a large amount of work in connexion with aviation lighting equipment A reflector type air beacon has been developed which on trial gave results closely approximating to the predetermined calculations In the new aerodrome flood-light there are nine reflectors of parabolic trough formation each equipped with 1000 watt tubular lamps With the help of a specially developed focusing device, the unit can be set up in daylight The results obtained by tests at night are very satisfactory

During the past three years commercial photometry has been passing through a transition stage All the visual methods used during the last forty or fifty years are steadily being superseded by photoelectric methods of measurement Three photoelectric photometers are at present in use at the G E C Research Laboratories which are capable of being used for several purposes They can, for example, measure the lumens on a direct reading lumen scale over a range of colour temperatures extending from 2400° K (absolute) to 2800° K approximately The lumens and colour measurements are both measured on direct reading scales, and so also are the measurement of lumens and lumens per watt These improvements save a great deal of time and greatly reduce the risk of error At the Osram lamp works a photoelectric photometer utilising a cubical photometric integrator of eight-foot side has been installed It has been designed more especially for the measurement of the very large lamps used in lighthouses, which often require 10,000 watts each



## Life and Work of William Henry Perkin

THE special honour and affection in which the late Prof W H Perkin was held by the Chemical Society is reflected in the publication of a special number of the Society's *Journal* (price 3s 6d) giving an account of the life and work of "this great master in organic chemistry". Prof Perkin, who was Longstaff medallist, first Pedler lecturer, and a past president of the Society, and had been most closely associated with the development of chemical studies and knowledge in the Universities of Manchester and Oxford, died on Sept 17, 1929.

The story of Perkin's life from the personal point of view has been written by Mr A J Greenaway, a life-long friend, and formerly editor of the Society's *Journal*, in which the results of most of his researches were published. His scientific work has been described by two of his old associates, Prof J F Thorpe, who confines himself to the Wurzburg, Munich, Edinburgh, and Manchester periods, 1880-1912, and Prof R Robinson, who discusses a selection of the subjects in the study of which Perkin was actively engaged: the constitution of berberine, brazilin and haematoxylin; harmine and harmaline, cryptopine and protopine. There is appended a bibliography of 271 papers published by Perkin and his collaborators, there are four posthumous papers on strychnine and brucine yet to be published. The book also includes three photographs of Perkin, and one of the memorial plaque presented in triplicate to the Society and the Universities of Manchester and Oxford by his colleagues and pupils.

William Henry Perkin was born on June 17, 1860, he was first sent to preparatory schools at Harrow, and later to the City of London School, chosen by his father, Sir William Perkin, founder of the coal-tar dye industry, not merely because it was his old school, but also because it was then "the only one he could find where science was taught". The science master was Henry Durham, who gave courses in chemistry, botany, and physiology alternately, and there was a practical chemistry class on Saturday afternoons, when the boys worked at the lecture table. In the garden of his father's house at Sudbury there was a hut fitted as a laboratory where the Perkin boys, W H and A G, were brought up in an atmosphere of research but without systematic instruction. In 1877, Perkin entered the Royal College of Chemistry at South Kensington and studied under Prof (later Sir Edward) Frankland and Dr W R E Hodgkinson, in 1880 he went to Wurzburg, studying chemistry under Wislicenus, physics under Kohlrausch, and mineralogy under Sandberger, and in 1882 he went to Munich to work under Baeyer. Here he established a claim to be regarded as one of the most promising of the younger chemists.

In 1887, Perkin was appointed the first professor of chemistry at the newly founded Heriot-Watt College at Edinburgh, his work on ring compounds was continued, much work on other subjects, including camphor, was undertaken, and the alkaloid investigations were commenced. The University of Manchester secured him in 1892, he then entered on what he once described as his 'golden age' of research, and his school established a world-wide reputation. Tempting offers of chairs elsewhere were refused, but in 1912, Perkin accepted the Waynflete professorship of chemistry at Oxford and a fellowship of Magdalen College. At Oxford he completely transformed the chemistry school, liberating a flood of new knowledge. Admirers of the man himself, genial and warm-hearted, and of his immense services to organic chemistry, will prize this triple tribute to his memory.

## University and Educational Intelligence

CAMBRIDGE.—Dr A G Hutchison, of Emmanuel College, has been appointed University demonstrator in mineralogy and petrology.

Dr R S Hutton, director of the British Non-Ferrous Metals Research Association, has been appointed the first Goldsmiths professor of metallurgy. Dr Hutton, who was educated at Blundell's School, Triverton, Owens College, Manchester, and the Universities of Leipzig and Paris, was lecturer in electro-metallurgy in the University of Manchester in 1900-8.

APPLICATIONS are invited by the University of Wales for five fellowships, each of the annual value of £200 and tenable for two years. The fellowships are open only to graduates of the University of Wales. Applications must reach the Registrar, University Registry, Cathays Park, Cardiff, by at latest June 1.

SCHOLARSHIPS for the encouragement of original research in sanitary science are again being offered by the Grocers Company. The value of each is £300 a year, plus an allowance for expenses in connexion with the work undertaken. Applications, upon a form supplied on request, must be received before the end of April by the Clerk to the Grocers Company, Grocers Hall, E C 2.

THE Board of Education announces that it is prepared to consider applications for full-time studentships from teachers with at least five years' teaching experience who desire financial assistance to follow courses of advanced study at universities or other institutions at home or abroad. Particulars of the awards and application forms are obtainable from the Board of Education, Whitehall, S W 1.

MEXICO'S Department of Education offers to a world, wrestling to balance its budgets, a signal example of how to achieve equal or better schooling with less outlay. In that country, it appears, rural schools are based on the idea of building up the community economically, socially, and spiritually, and there is consequently a prejudice against residential schools as alienating children from their home surroundings. However, an exception was allowed in the case of Indians afflicted with a certain disfiguring but evidently not disabling disease (*mal del pinta*), and a party of thirty-five, ranging in age from ten to eighteen years, was assembled last April on a forty-acre site at San Gabrielito and set to work to make a residential school. Arriving with nothing but a blanket each and the clothes they stood up in, they were made to construct for themselves, sleeping the while on the bare ground, with clay and timber found on the spot, a sufficient and attractive building with necessary furniture, and to make shoes, belts, hats, chairs, and other articles for sale to obtain the wherewithal to buy such clothing as they needed and could not make, and instruments for a school orchestra. Within three months, the school was in successful operation. These facts are recorded in an article contributed by Mrs Cook, chief of the special problems division of the Office of Education, Washington, to the October number of *School Life*. The same number contains a significant excerpt from an address by the Secretary of the Interior, the general drift of which is summed up in the following words: "Never was there a time when studies and experiments in the vocational training of our youth were more necessary than to-day. We must not let the fetish of cultural education interfere with an up-to-date and effective training of our children."



## Calendar of Geographical Exploration

March 14, 1864 —Lake Albert Nyanza

Sir S W Butler discovered Lake Albert Nyanza. He had set out in March 1861 upon his first tour of exploration in Central Africa "to discover the sources of the Nile, with the hope of meeting the East African expedition under captains Speke and Grant, somewhere about the Victoria Lake". He spent a year on the Sudan-Abyssinian border, and explored the Atbara and other tributaries of the Nile, proving that the Nile sediment came from Abyssinia. In 1863 he met Speke and Grant, who had discovered the sources of the Nile, but whose information suggested the possibility of the discovery of the above-mentioned lake. Though he was unable to explore its coasts fully, he examined its eastern shore and discovered the Murchison Falls.

March 15, 1846 —Huc's Travels

Évariste Régis Huc and Joseph Gabet were sent back from Lhasa by order of the Chinese Ambassador, under escort, by the rugged route to Szechwan, finally reaching Canton. Huc remained there three years and then returned to Europe. Europeans were, so far as possible, excluded from Tibet in the nineteenth century, though an English traveller, Thomas Manning, reached Lhasa in 1811–12, but left no useful records. The Abbé Huc set out for China in 1839, spent some time in the southern provinces and in Peking, and finally settled in the Valley of the Black Waters or He Shuy, just within the borders of Mongolia. There he studied the dialect and customs of the Tatars. In 1844, accompanied by J Gabet and a converted Tibetan, all three disguised as lamas, they started for Tibet from Dolon Nor. They crossed the Hwang-ho and the terrible Ordos desert, reached Kansu, recrossed the flooded Hwang-ho, and in January 1845 arrived at Tang-kuil, where they stayed eight months studying the language. A large Tibetan embassy returning from Peking allowed them to join it and they penetrated to Lhasa via the Koko Nor desert and the snow-clad mountains. They stayed in Lhasa from January to March and opened a little chapel. Huc's "*Souvenirs d'un voyage dans la Tartarie, le Thibet et la Chine*" is one of the most delightful travel books ever written.

March 17, 1796 —Japan and Sakhalin

W R Broughton, in the *Providence*, reached Nootka Sound. He had accompanied Vancouver in 1791, but had been sent back with dispatches and had obtained a commission to complete the outline of the north Pacific coast on the Asiatic side. Finding that Vancouver had returned home, Broughton returned to the Sandwich Isles, which he left in August, and sighted Japan on Sept 7. Before his return to England in 1799, Broughton surveyed the east coast of Yezo, touched at several of the Kuriles, sighted Fujiyama, examined parts of Nippon and Sakhalin, and crossed the channel which now bears his name. His voyage supplemented the work of La Pérouse, though like the latter he failed to traverse the narrowest part of the strait between Sakhalin and the main land and to reach the mouth of the Amur.

March 19, 1870 —Schweinfurth's Travels in Africa

G. Schweinfurth reached the Welle River, south of the Niam Niam country. He had started from Khartum in 1868, intending to explore the western tributaries of the Upper Nile and to record the botany of the region. He had also heard rumours of a great river that flowed to the west, south of the Niam Niam land,

which was not connected with the Nile and upon the shores of which lived a race quite distinct from the usual type of negro. When he reached the river he found that the rumours were correct. He did not realise that it was an affluent of the Ubanga, but thought that it was the upper course of the Shari, or possibly that it joined the Benue. Schweinfurth had previously explored the coasts of the Red Sea and reached Khartum through Abyssinia (1863–66). His fine descriptions of the regions through which he passed and of the people dwelling in them have become classics for the study of this part of Africa. The relation of the Welle River to the Ubanga was demonstrated in 1885 through the work of Junker and Grenfell.

## Societies and Academies

LONDON

Royal Society, March 3 —J C McLennan, A C Burton, A Pitt, and J O Wilhelm. The phenomena of superconductivity with alternating currents of high-frequency. With currents of frequency  $1.1 \times 10^7$  per second a coil of lead wire showed an abrupt loss of resistance, of relatively large amount, at a temperature that appeared to be slightly lower than the critical temperature  $7.2^\circ \text{K}$  characteristic of the transition to superconductivity, found for the same wire with direct current. With a coil of tin wire, drawn to a diameter of  $0.3 \text{ mm}$ , it was found that with direct currents the resistance of the coil began to decrease abruptly at  $3.76^\circ \text{K}$  and disappeared completely at  $3.70^\circ \text{K}$ . Experiments with the same coil with currents of frequency  $1.1 \times 10^7$  per second gave for the corresponding temperatures  $3.67^\circ \text{K}$  and  $3.61^\circ \text{K}$ . Further experiments with higher frequencies revealed depressions of the critical transition temperature increasing in amount with the frequency. Extrapolation of the transition temperature-frequency curve, which appeared to be linear for the higher frequencies, gave  $10^\circ$  per second for the frequency corresponding to  $0^\circ \text{K}$ . With tantalum wires results were obtained similar in character to those found with wires of tin and of lead. Polarisation and orientation phenomena are involved in the production of the superconducting state in metals. This electrical state appears, in part at least, to be somewhat analogous to the saturated magnetic state obtainable with ferromagnetic metals. (See also NATURE, 128, p 1004, 1931) —G I Taylor. The transport of vorticity and heat through fluids in turbulent motion. The theory that the dynamics of turbulent motion should be regarded as an effect of diffusion of vorticity rather than as a diffusion of momentum was put forward by the author in 1916, and the particular case when the whole motion is limited to two dimensions was then discussed. The analysis is now extended to three-dimensional motion, and it is shown that the 'momentum transport' theory of Reynolds and Prandtl agrees with the 'vorticity transport' theory in one case only, namely, when the turbulent motion is of a two-dimensional type, being confined to the plane perpendicular to the mean motion. When the turbulent motion as well as the mean motion is confined to two dimensions, the vorticity transport theory yields results which are quite different from those predicted by the momentum transport theory. The distribution of temperature and velocity in the wake behind a heated obstacle for the case of two-dimensional motion, when the turbulent motion is confined to the plane of the mean motion, is in accord with the vorticity transport theory —A Fage and H C H Townend. An examination of turbulent flow with an ultramicroscope

Minute particles present in tap water were intensely illuminated and viewed against a dark background. These particles were small enough to show the Brownian movement when the fluid was at rest. The illuminated particles were used to follow the motion of the fluid, and enabled the maximum values  $u_1$ ,  $v_1$ , and  $w_1$  of the three components  $u$ ,  $v$ , and  $w$  of the velocity disturbance at any point and the distribution of the mean velocity  $U$  across the pipe to be made without introducing any instruments into the fluid. At the centre of the pipe,  $u_1$ ,  $v_1$ , and  $w_1$  were approximately equal. As the wall was approached,  $v_1/U$  obtained from the velocity disturbance normal to the wall decreased to zero, whilst  $u_1/U$  and  $w_1/U$  increased. At the wall itself, whilst the flow tended to the laminar type, the motions of particles in the laminae were sinuous, even to within a distance of  $1/40,000$  in from the wall. No particle was seen to move in a rectilinear path.

Mineralogical Society, Jan 19.—L. J. Spencer. A new pallasite from Alice Springs, Central Australia. A fragment weighing 1084 grm was collected by Dr Herbert Basedow in 1924 on the north side of the MacDonnell Ranges about ten miles north of Alice Springs, and has been generously presented by him to the British Museum collection of meteorites. It is a typical pallasite, consisting of 40 per cent of olivine (with  $\text{FeO} \cdot \text{MgO} = 4 \cdot 6$ ) and 60 per cent of nickel-iron ( $\text{Fe} \cdot \text{Ni} = 12 \cdot 7$ ) with a little troilite. Small angular fragments of olivine are embedded in the kamacite, suggesting that the olivine had been broken up before the kamacite crystallised out. The granular texture of the metal also suggests that the kamacite had been broken up with the development of Neumann lines before the separation of the taenite and plessite, and that the fragments had been partly re-dissolved in the residual melt, giving the reaction-rim of taenite. The plessite eutectic separated out in the small interspaces.—Arthur Russell. An account of British mineral collectors and dealers in the seventeenth, eighteenth, and nineteenth centuries (contd). Short biographies dealing with Robert Wern Fox (1789–1877), Wilson Lowry (1762–1824), and Thomas Hogg.—M. H. Hey. Studies on the zeolites (3). Natrolite and metanatrrolite. Natrolite is shown by nine new analyses and new X-ray measurements to have a constant  $\text{Si}/\text{Al}$ -ratio and a unit-cell formula of  $\text{Na}_{16}\text{Al}_{16}\text{Si}_{24}\text{O}_{80} \cdot 16\text{H}_2\text{O}$ , in agreement with previous results.  $\text{Na}_2 \rightarrow \text{Ca}$  replacement may occur up to about 4, and  $\text{Na} \rightarrow \text{K}$  replacement up to about 2 atoms per unit-cell. Natural etch-figures in natrolite from Benallt, Carnarvonshire (a new locality for natrolite), show the symmetry to be didigonal polar ( $C_{2v}$ ). A detailed study of the optical properties of natrolite has been made. Some observations have been made on the effects of partial dehydration on the optical properties. The vapour pressure has been studied at various temperatures and degrees of dehydration, and a discontinuity in physical properties at a water content of 15 mols per unit-cell observed. Some experiments have been carried out on the base-exchange of natrolite. Optical and X-ray examinations of metanatrrolite have been made.

Royal Meteorological Society, Feb 17.—W. H. Pick. Visibility at sea. The open ocean in the eastern North Atlantic is a region of singularly good visibility, both in summer and in winter. The highest percentages of good visibilities occur with the air temperature less than the sea temperature, but the fact that high percentages of good visibilities are also obtained with air that is warmer than the sea beneath is noteworthy. With regard to wind force, the lowest percentages of good visibilities occur with

the strongest winds. The large majority of fogs occur with air temperature either greater than or equal to the sea temperature, but there is an appreciable residue that occur when the air temperature is lower than the sea temperature.—M. G. Bennett. The visual range of lights at night and its relation to the visual range of ordinary objects by day. The visual range of a point source of light is given by the formula  $(\text{Intensity} \times \text{Transmission})/(\text{Distance})^2 = \text{constant}$ . Experiments are described from which an empirical formula connecting this constant and the brightness of the background is derived.—S. E. Ashmore. The occurrence of fog with unsaturated air at Grayshott, Hants. The relation of such fogs to accompanying meteorological factors, such as wind and cloud, has been analysed. The results appear in some degree to contradict the smoke theory of unsaturated fogs.

## PARIS

Academy of Sciences, Jan 25.—Maurice Hamy. The equation obtained by equating to zero the distance of two planets which do not meet at real points.—Charles Nicolle and Charles Anderson. The sensibility of the pig to African strains of *Spirochaeta hispanicum*. The pig can contract recurrent fever from the African strains of spirochaete, but there is no appreciable symptom. No spirochaetes can be detected microscopically in the blood, but this blood is virulent to sensitive animals.—Emile Cotton. Integrals dependent on variable parameters.—C. Gutton and G. Beauvais. The high frequency discharge. Experimental study of the relation between the distance of the electrodes and the effective potential difference at which the discharge ceases.—Constant Lurquin. The generating functions of Laplace.—J. Favard. A definition of length and of area.—D. Pompeiu. Functions of two real variables.—R. Gosse. The integration of a partial differential equation.—Pasquier. The equations  $s = f(x, y, z, p, q)$  integrable by the method of Darboux.—Vladimir Bernstein. The analogy between the distribution of Julia's right lines of holomorphic functions and that of the singular points of analytical functions.—Nikola Obrechikoff. A generalisation of the Mittag-Leffler summation.—Thadée Banachiewicz. The calculation of the hypotheses in the Gauss-Encke method of the determination of orbits.—W. Swietoslawski, A. Zmaczynski, and J. Usakiewicz. The boiling point of ethyl alcohol. Three specimens of ethyl alcohol, dehydrated by different methods, gave boiling points  $78 \cdot 320^\circ$ ,  $78 \cdot 318^\circ$ , and  $78 \cdot 319^\circ \text{C}$ , as measured with an electrical resistance thermometer. This is appreciably lower than the figure given by Darbaudy and Lalande ( $78 \cdot 385^\circ$ ).—G. A. Beauvais. A point of potential stability of an isolated electrode of a triode valve.—Jean Thibaud. The production of positive ions of high velocity by multiple accelerations.—Mlle Y. Cauchois. Luminous spectra by transmission of non-canalised X-rays through a curved mica sheet.—Marcel Dufour. The astigmatism of the oblique pencil refracted by the spherical diopter.—J. P. Mathieu. The rotation of naphthylene-bisuminocamphor and the theory of Werner Kuhn. Correction to an earlier communication. There is no disagreement between the figures calculated from the author's experiments and those deduced from W. Kuhn's theory.—Roger Servant. The rotatory dispersion in the ultra-violet of the  $\alpha$ - and  $\beta$ -pinenes in solution in ethyl alcohol.—Lucien Mallet. Ionisation chambers of very small dimensions designed for the local measurement of the  $\gamma$ -radiation. The small size of the ionisation chamber described and illustrated, and its complete independence with respect to the measuring instrument, allows measurements of radiation received in a well-defined region.—A. Michel-Levy and H. Muraour. The influence of

diphenylamine, of aniline, and of certain of its derivatives on the double refraction of the nitrocelluloses—Gaston Charlot The catalytic oxidation of toluene As an indication of the course of a catalytic reaction, a gaseous mixture of air and toluene, of known composition, is passed over the catalyst at varying temperatures, and the proportions of carbon dioxide and oxygen in the issuing gases determined by the ordinary methods of gas analysis—A Perret and A M Krawczynski Some complex peroxides of hexamethylene-tetramine A description of addition products to hexamethylene-tetramine with benzoyl peroxide and with acetyl-benzoyl peroxide—Marcel Godchot and Maurice Imbert Some syntheses of glycols with ether oxide function—M Battagay and H Silbermann The anthraquinonylguanidines—A Marin and P Fallot The transgressive *Flysch* on the Riffian Palaeozoic—M Mascré and H Génot The influence of various manures on the development and alkaloid content of *Lobelia inflata*—E Lobstein and J Grumbach The study of an alkaloid extracted from the root of *Stemona tuberosa*, a Chinese-Annamese drug The name 'stemonine' is given to a new alkaloid extracted by the Stas-Otto method from this root Its composition is  $C_{22}H_{33}NO_4$ , its physical, chemical, and biological properties are described—E Roubaud The phenomena of postnymphal larval histolysis and autotrophic imaginal nutrition in *Culex pipiens*—V Pachon and R Fabre The functional rôle of the stomach gas bubble—D Auger and A Fessard The isochronisms of the action potentials of the electric nerve of the torpedo and of its effector—Maurice Fontaine The relation in marine and river fish between the proportion of inorganic phosphorus in the serum and the ossification of the skeleton—Jean Regnier and Mlle Alice Kaplan Contribution to the numerical study of microbial multiplication The influence of the number of micro-organisms planted on the velocity of their multiplication—Marcandier and Robert Pirot The presence of a virus, similar to that of exanthematic typhus, in rats from warships at Toulon—Pierre Lepine The presence in the encephalus of rats caught at Athens of a virus assuming the experimental characters of exanthematic typhus (Mexican typhus)

## LENINGRAD

Academy of Sciences—*Comptes rendus*, No 9, 1931—V Mitkevitch Practical magnetic units In addition to the 'pro-maxwell', which is a unit of magnetic flux adopted by the International Electrotechnical Commission at its meeting in Stockholm in 1930, the author proposes the following units 'pro-gilbert', for magnetomotive force, 'pro-hopkins', for magnetic resistance (the name given in honour of J Hopkinson), 'pro-gauss', for magnetic induction, and 'pro-oersted', for magnetic power—N Malkin A solution of the magnetometric problem in the case of a single surface of separation (the case of schistous deposits)—N Filipjev Lepidopterological notes (10) Specific independence of *Gracillaria betulicola* Hering The species differs in the structure of the male genitalia from *G elongella*, L—V Kistiakovsky Methods of studying the problem of corrosion of metallic parts of oil tankers Theoretical principles of the corrosion are discussed and a preliminary recommendation is made to cover the metallic parts with liquid glass, composed as follows 1 gm liquid sodium silicate, 2 gm sodium chloride, and 100 gm water—A Martynov The suborder *Permanisoptera*, nom n (Odonata), and its systematic position The name *Protanisoptera*, given by the author to the suborder including his family *Permaeschnidae*, proved to be preoccupied, and a new name is proposed instead

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## Forthcoming Events

## FRIDAY, MARCH 11

ROYAL ANTHROPOLOGICAL INSTITUTE (Sociological Research Committee), at 4—Miss C H Wedgwood Stages of Economic Development in Melanesia  
ROYAL SOCIETY OF ARTS, at 4 30—Indian Meeting  
SOCIETY OF CHEMICAL INDUSTRY (Newcastle-upon-Tyne Section) (at Armstrong College, Newcastle-upon-Tyne), at 7—Annual General Meeting

## SATURDAY, MARCH 12

ROYAL INSTITUTION OF GREAT BRITAIN, at 3—Lord Rutherford of Nelson Discovery and Properties of the Electron (3)

## MONDAY, MARCH 14

BIOCHEMICAL SOCIETY (at University College), at 3—Annual General Meeting  
KING'S COLLEGE, LONDON, at 5 30—Prof Julian S Huxley Travels and Politics in Tropical East Africa (Lecture)  
INSTITUTE OF MECHANICAL ENGINEERS (Graduates' Section—London), at 6 45—Dr W H Hatfield The Strength and Behaviour of Steels at High Temperatures (Annual Lecture)  
INSTITUTE OF METALS (Scottish Local Section) (Annual General Meeting) (at 39 Elmbank Crescent, Glasgow), at 7 30—J Stirling Condenser Tubes and their Packing  
ROYAL SOCIETY OF ARTS, at 8—A E L Chorlton Oil Engine Traction (Howard Lectures) (2)

## TUESDAY, MARCH 15

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5—Dr C E Lakin The Borderlands of Medicine (Lumleian Lectures) (2)  
INSTITUTE OF INDUSTRIAL ADMINISTRATION (at Institute of Hygiene, 28 Portland Place, W 1), at 6 30—T G Rose The Management Audit (Address)  
INSTITUTE OF ELECTRICAL ENGINEERS (North Midland Centre) (at Albert Hall, Leeds), at 7 30—Prof J K Catterton-Smith Everyday Uses of Electricity (Faraday Lecture)  
INSTITUTE OF METALS (North-East Coast Local Section) (Annual General Meeting) (at Armstrong College, Newcastle-upon-Tyne), at 7 30—R D Burn Refining of Copper  
ROYAL SOCIETY OF MEDICINE (Pathology Section), at 8 30—Annual General Meeting

## WEDNESDAY, MARCH 16

SCHOOL OF ORIENTAL STUDIES, at 5 15—J H Driberg African Systems of Education (Lecture)  
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (Annual Meeting) (at Liverpool University), at 6—Dr H A Harrison The Evaluation of Wood Pulp for Strength  
ROYAL METEOROLOGICAL SOCIETY, at 7 30—Dr B A Keen Soil Physics in Relation to Meteorology (G J Symons Memorial Lecture)  
ROYAL SOCIETY OF ARTS, at 8—Dr E F Armstrong Hydrogen and its Uses (Lecture)

## THURSDAY, MARCH 17

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5—Dr C E Lakin The Borderlands of Medicine (Lumleian Lectures) (3)  
ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15—Prof J B S Haldane Heredity in Man (5)

## FRIDAY, MARCH 18

GLASGOW CHEMICAL SOCIETY (Annual General Meeting) (at Glasgow University), at 4—Prof G G Henderson Publication of Chemical Literature (Presidential Address)  
PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5—Annual General Meeting, followed by an ordinary meeting

UNIVERSITY COLLEGE, at 5 30—Prof A J Toynbee The Turks (Lecture)  
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Thomas' Café, Swansea), at 7 30—Annual Meeting  
ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Lord Rutherford of Nelson Recent Researches on the Gamma Rays

### SATURDAY, MARCH 19

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3—F C Boon Teaching the Method of Ratio (Lecture)  
ROYAL INSTITUTION OF GREAT BRITAIN, at 3—Lord Rutherford of Nelson Discovery and Properties of the Electron (4)

### Congresses

MARCH 14 AND 15

GERMAN SOCIETY FOR THE INVESTIGATION OF THE CIRCULATION (at Tübingen)

Prof O Muller The Blood Pressure Disease in Swabia  
Prof von Skramlik The Blood Pressure in Animals  
Dr M Nordmann The General Pathology of the Peripheral Circulation  
Prof E Gabbe The Circulation and Utilisation of the Blood in the Periphery

MARCH 15 TO 18

INTERNATIONAL SOCIETY OF SURGERY (at Madrid)—Subjects for Discussion Non-tuberculous Pulmonary Suppuration, The Diagnosis and Treatment of Intra-spinal Tumours, The Surgery of the Oesophagus, and Recent Progress in Surgical Anaesthesia

MARCH 16 TO 18

INSTITUTION OF NAVAL ARCHITECTS (at Royal Society of Arts), at 10 30 A M—Reading and Discussion of Papers

## Official Publications Received

### BRITISH

The Kent Incorporated Society for Promoting Experiments in Horticulture Annual Report (Eighteenth Year) 1930 1 General East Malling Research Station, Kent, 1st January 1930 to 31st December 1930 (A. 13) Pp 162 3s 6d Annual Report (Sixteenth, Seventeenth and Eighteenth Years) 1928, 1929 and 1930 2 Supplement East Malling Research Station (A. 14) Pp 221+19 plates 6s (East Malling)  
Proceedings of the Royal Society of Edinburgh, Session 1931-1932 Vol 52, Part 2, No 2 The Employment of Intracardiac Injection of Adrenaline in Asphyxia By Sir E Sharpey Schafer and William A Bain Pp 139 151+6 plates 4s Vol 52, Part 2, No 3 The Absorption Spectra of Cyanogen and the Cyanogen Halides By Dr R B Mooney and H G Reid Pp 152 153 6d (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd.)  
Empire Cotton Growing Corporation Reports received from Experiment Stations, 1930-1931 Pp xi+242 (London) 2s 6d  
The Institution of Mechanical Engineers Annual Report of the Council for the Year 1931 Pp 44 (London)  
University of London University College Report of the University College Committee (February 1931-February 1932), with Financial Statements (for the Session 1930-31), and other Documents, for Presentation to the Court and the Senate Pp ii+164 (London Taylor and Francis)  
The Controversy between Determinism and Vitalism in Biology: the Third Lister Lecture delivered to the Quaker Medical Society, November 5th, 1931 By Prof A J Clark Pp 22 (Leominster The Orphans' Printing Press, Ltd.)  
The Linen Industry Research Association Report of the Council, 1931 Pp 23 (Lambeg, Belfast)  
Association of Technical Institutions Paper read at the Annual General Meeting, February 26th and 27th, 1932, on Technical Education and the Bakery Trade By W H Quinn Pp 22 6d Paper read at the Annual General Meeting, February 26th and 27th, 1932, on The Teaching of Modern Languages in Technical Colleges By P G Wilson Pp 13 6d Paper read at the Annual General Meeting, February 26th and 27th, 1932, on Technical Education in Canada By Prof Robert W Angus Pp 7 6d Agenda Paper and Report of Council (1931) for the Annual General Meeting to be held on Friday, February 26th, and Saturday, February 27th, 1932, at the Feathersellers' Hall, St Helen's Place, London, E.C. Pp 34 (Loughborough Hon Secretary, Association of Technical Institutions, Loughborough College)  
Association of Technical Institutions and Association of Principals of Technical Institutions Report on Policy in Technical Education, by a Joint Committee Pp 44 (Loughborough Hon Secretary, Association of Technical Institutions, Loughborough College)  
Chemistry and the Community By Sir Frank E Smith (The Third S M Gluckstein Memorial Lecture, 1931) Pp 22 (London Institute of Chemistry of Great Britain and Ireland)

Asiatic Society of Bengal Annual Report for 1931 Pp 36 Presidential Address, 1932 By U N Brahmachari Pp 34 (Calcutta)  
Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 55 The Basal (Standard) Metabolism of the Australian Merino Sheep By E W Lines, with the assistance of A W Prince Pp 34 Pamphlet No 23 Refrigeration applied to the Preservation and Transport of Australian Foodstuffs, a Survey and a Scheme for Research By Dr J R Vickery Pp 40 (Melbourne H J Green)  
Transactions of the Mining and Geological Institute of India Vol 26, Part 2, October Pp 69-168+6 plates 4 rupees Vol 26, Part 3, November Pp 169-275+plates 7 26 4 rupees (Calcutta)  
The Indian Forest Records Silviculture Series, Vol 16, Part 7 Notes on *Pinus longifolia* Roxb.—The Plantations in Dehra Dun and the Central Provinces and Miscellaneous Seed Studies By H G Champion and B D Pant Pp v+25+9 plates (Calcutta Government of India Central Publication Branch) 1 10 rupees, 2s 9d  
Royal Botanic Gardens, Kew Bulletin of Miscellaneous Information, 1931 Pp iv+512+105+15 plates (London H M Stationery Office) 15s net  
University of Leeds Publications and Abstracts of Theses by Members of the University during Session 1930-31 Pp 28 Twenty seventh Report, 1930-31 Pp 169 (Leeds)

### FOREIGN

Columbia University Bulletin of Information Thirty second Series, No 18 Announcement of Professional Courses in Optometry for the Winter and Spring Sessions, 1932-1933 Pp 31+3 plates (New York City)  
Conseil Permanent International pour l'Exploration de la Mer Rapports et procès-verbaux des réunions, Vol 77 Rapport atlantique 1930 (Travaux de Comité du Plateau Continental Atlantique) (Atlantic Slope Committee) Publié avec l'aide de Dr Ed Le Danos et Rafael De Buen Pp 88 (Copenhagen Andr Fred Høst et fils) 3 50 kr  
Académie des Sciences de l'Institut de France Les membres et les correspondants de l'Académie Royale des Sciences, 1666-1793 Pp xvi+205 (Paris)  
Department of Agriculture, Straits Settlements and Federated Malay States Scientific Series, No 8 The Control and Economic Importance of the Greater Coconut Spike Moth (*Irrathada rufivena* Walk.) By G H Corbett Pp 14 (Kuala Lumpur) 50 cents  
Merentutkimuslaitoksen Julkaisus Havsforskningsinstitutets Skrift No 73 Strom- und Windbeobachtungen an den Feuerschiffen in den Jahren 1928 und 1929 Von E Palmén Pp 58 20 Fmk No 74 Vedenkorkeusarvoja 1928 (Vattenståndsuppgifter 1928) Av S E Stenij Referat Wasserstandangaben 1928 Pp 51 20 Fmk No 75 Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres, Juli 1929 Juni 1930 Herausgegeben von Gunnar Granquist Pp 47 25 Fmk No 76 Water Level Records from Finland previous to 1913 By Henrik Renquist Pp 176 60 Fmk No 77 Havsforsknings institutets verksamhet år 1930 Redogörelse avgiven av Rolf Witting Pp 14 10 Fmk No 78 Croisière thalassologique et observations en bateaux routiers en 1930 Rédigé par Risto Jurva Pp 48 20 Fmk No 79 Översikt av isarna vintern 1930 31 Av Gunnar Granquist Referat Übersicht der Eisverhältnisse im Winter 1930 31 an den Küsten Finnlands Pp 54 25 Fmk (Helsinki)  
Societas Scientiarum Fennica Commentationes Physico Mathematicae, V, 12 Untersuchungen über die Strömungen in den Finnland umgebenden Meeren Von E Palmén Pp 94 (Helsingfors Akademische Buchhandlung)  
State of Connecticut State Geological and Natural History Survey Bulletin No 51 The Minerals of Connecticut By Dr John Frank Schairer (Public Document No 47) Pp 121 (Hartford, Conn State Library) 75 cents  
Smithsonian Miscellaneous Collections Vol 85, No 11 Supplementary Notes on Body Radiation By L B Aldrich (Publication 8131) Pp 12 Vol 87, No 1 The Botanical Collections of William Lobb in Colombia By Ellsworth P Killip (Publication 3133) Pp 13 Vol 87, No 4 The Periodometer, an Instrument for Finding and Evaluating Periodicities in Long Series of Observations By C G Abbot (Publication 3138) Pp 6+1 plate (Washington, D C Smithsonian Institution)  
The University of the State of New York The State Education Department Tentative Syllabus in General Biology Pp 62 (Albany, N Y University of the State of New York Press)  
Mémoires de la Société de Physique et d'Histoire Naturelle de Genève Vol 44, Fasc 1 Les Sporozoaires (Cycles chromosomiques et sexualité) Par André Naville Pp 224 (Geneve Georg et Cie) 15 frs  
Journal of the Imperial Agricultural Experiment Station, Nishigahara, Tokyo Vol 1, No 4, March 1931 Pp 263-422+plates 27-35 (Tokyo)  
Japanese Journal of Mathematics Transactions and Abstracts, Vol 8, No 3, December Pp 113-236 (Tokyo National Research Council of Japan)  
Instituts scientifiques de Buitenzorg "s Lands Plantentuin" Treubia recueil de travaux zoologiques, hydrobiologiques et océanographiques Vol 13, livraison 3 4, décembre Pp 293 482 (Buitenzorg Archipel Drukkerij) 5 00 f  
Proceedings of the American Philosophical Society Vol 70, No 5 Pp xviii+399 410 (Philadelphia)  
Proceedings of the United States National Museum Vol 80, Art 5 Behndorms from the Islands of Niuafoou and Nukualofa, Tonga Archipelago, with the Description of a New Genus and two New Species By Austin H Clark (No 2905) Pp 12+8 plates (Washington, D C Government Printing Office)  
The Science Reports of the Tôhoku Imperial University, Sendai, Japan Fourth Series (Biology), Vol 6, No 4, December Pp 573-809+plates 19 21 (Tokyo and Sendai Maruzen Co, Ltd)

### CATALOGUES

Books on various Subjects in new Condition at much reduced Prices (No 463) Pp 24 (Cambridge Bowes and Bowes)  
Verzeichnis der Werke und Zeitschriften der Akademischen Verlagsgesellschaft m b H, Leipzig Pp 87 (Leipzig Akademische Verlagsgesellschaft m b H)



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## The Ready Supply of Cinchona and Quinine: an Urgent Need

UNDER the title "Ledger Bark and Red Bark", Mr J H Holland contributes, in the current number of the *Kew Bulletin of Miscellaneous Information* (No 1, 1932, pp 1-17), an important paper upon the past and present position of cinchona cultivation and quinine production. He has gathered together the salient facts relating to the availability of quinine and he presents these to us, without criticism, brought right up to date and from the varied points of view of the several parties which are most concerned.

After a short account of the introduction of cinchona from South America to India and Java—a story too well known to need repetition here—Mr Holland discusses the therapeutic value both of quinine and of the other cinchona alkaloids. Evidence is brought to show that the alkaloids other than quinine are regarded by medical experts to be, at least for some forms of malaria, quite as efficacious as quinine, which is the only cinchona alkaloid admitted to the "British Pharmacopœia". It may be pointed out that this is not just a return to the findings of the commissions in India in 1866, which recognised the value of cinchona febrifuge, but a distinct step forward. The old cinchona febrifuge was a mixture of all the alkaloids, whereas the new febrifuges, under such names as 'malarene' and 'totaquina', are the factory residues after most of the quinine has been extracted from the bark. This modern view of the value of the febrifuge is important, since, if it becomes generally accepted, it will ensure that the whole of the cinchona products can be utilised.

In the same paragraph of Mr Holland's paper, the old bogey which has so often hindered the adoption of a forward policy in the production of quinine—the synthetic substitute—is, for the present at all events, laid to rest. Beprochin and plasmoquine have now been under trial, but, although it is claimed for the latter that it effectively prevents mosquito-borne malarial infection among a group of healthy individuals who take prophylactic doses, "both are costly to produce and it does not seem at all likely that they will take the place of the natural cinchona alkaloids".

From the observations made upon the species and varieties of cinchona at present under cultivation, it is clear that *Cinchona Ledgeriana* has the highest total alkaloid content. It and its hybrids will, therefore, be the best species to plant, except in special cases where *Cinchona succirubra* or

*C. officinalis* may have to be substituted. This will apply particularly when the locality which it is desired to plant is respectively below or above the optimum elevation for *C. Ledgeriana*. In India, this is approximately from 3000 feet to 5000 feet above sea-level.

With regard to countries other than Java and India in which cinchona is now cultivated, a short explanatory note would have made the position clearer. The citation of their names without such explanation may mislead those who are not well acquainted with the circumstances, for outside Java and India, the cultivation of cinchona amounts to no more than a few acres, and sometimes only to specimen trees.

It is to be regretted also that a more complete account of the present-day production of cinchona has not been given, for this, of course, has a very important bearing upon the present situation. The plantations of Java, which yield about ninety-four per cent of the world's supply of quinine, are allotted only a few lines, and most of the information given has been taken from Sand's account in the *Malayan Journal of Agriculture* of 1922. Moreover, such facts about the present position as are recorded refer mainly to Madras, the less important area in India. The figures relating to the areas under cultivation in India and to the amount of bark produced are taken from the Government reports for the years 1928-29 and 1929-30. Unfortunately, they give no true idea of the possible or probable annual Empire yield, for this depends upon the conditions of these plantations. About this a good deal can be gathered if the reports are carefully read all through. Such information is by no means revealed by the quoted figures. Furthermore, considerable attention is paid to the 753 acres in the Anamalais, still a speculative proposition while the Government of India's undertaking at Mergui in Burma is not mentioned. The latter area is about the same size as the former, and its present state is described in reports of the Botanical Survey of India.

An important point to which Mr. Holland directs attention, however, is the fact that the cinchona industry has now little or nothing to fear from competition with the original sources of bark in South America.

The main purpose of the paper is to produce evidence of the need for the expansion of cinchona cultivation, to indicate the regions in which it might successfully be grown, to point to the most profitable species to cultivate, and thus to stimulate action by the grower, the manufacturer, and the

user, which will result in an adequate supply of quinine at a price that will permit of its universal use by the malaria-stricken millions of the world. Having made these points, Mr. Holland leaves us to draw our own conclusions.

We have already published in *NATURE* (vol. 124, p. 881, 1929) an article upon the importance of this subject from the Empire point of view. As was pointed out there, the British Empire includes a large proportion of the malarial tracts of the world, and the late Sir Andrew Balfour estimated that the direct annual loss to the Empire by sickness and death due to malaria is between fifty-two and sixty-two million pounds sterling. The international aspect of malaria is shown by the fact that the League of Nations has set up an organisation for antimalarial work. There should be no need to lay further stress upon the necessity of increasing the production of cinchona and quinine. A perusal of the recent reports of the departments of the Governments of India, Bengal, and Madras, the only producers of quinine within the Empire, will show the present condition of our industry. The older plantation enclosures in Madras and Bengal, which extend to a good many square miles, have been entirely planted, so far as the land within them is suitable for cinchona. Fresh soil is no longer available, some years ago it became entirely exhausted. Unless an area be fallowed for a long period in forest, it will not produce a second satisfactory crop of cinchona. The present harvests are largely from the bark of dead and dying trees. Successful cultivation in the Anamalais is as yet by no means assured, and the Mergui area cannot be regarded as at all approaching a first-class area.

There has been no systematic working scheme, staffs are denuded, and research has been almost neglected. Our supplies will shortly decrease for lack of a forward policy under a single central control. Yet it has been estimated that, if India were to supply even her own needs, she would have to increase her output by eighteen times. What of the rest of the Empire? With the passage of time, land suitable for cinchona (and it has to be very carefully selected) has become more and more scarce.

Surely the time has come when steps should be taken to stimulate action. There is here a case which seems to call for active encouragement and aid in organisation, possibly by a small Commission set up by the Government at home which would survey the possibilities of producing cinchona, not only in India, but also in other parts of the British Empire.



### The Politics of Science

*What are We to do with our Lives?* By H. G. Wells  
Pp vi+148 (London William Heinemann,  
Ltd, 1932) 3s 6d net

THERE is nowadays scarcely an issue of *NATURE* which does not call upon scientific men to unite for ends beyond the specialised discussion of their own work. That the appeal does not entirely fail of response is shown by the slowly growing professional and social organisation of the scientific world and by the formation of propagandist societies which seek to impress upon the general public the importance of science in industry and government.

All this activity indicates a growing conviction among scientific men that science has something to contribute to the modern world beyond her technical applications—that its spirit and method carry with them implications of a rule of life, for human society as well as for the individual, and of a vision for the lack of which the people perish.

The practical working out of this increasing desire for a political movement based on science has proved, however, unexpectedly difficult. Scientific men are inevitably busy and preoccupied, and by the standard of their needs they are poor. Their calling has in the past made for a high degree of individualism; they have been able to combine for discussion and publication but for very little else. Moreover, the tradition of the pioneers who worked for knowledge and disdained its material prizes has prevented the development of the powerful 'trade union' types of organisation which have elsewhere provided the economic foundations of policy. A far more serious obstacle has been that the world of science has never made up its mind what it wants from politics. It has never got within sight of a political programme of its own, and it appears to accept conventional party divisions as real and important just when the general deliquescence of politics has revealed them as the superficial things they are.

The book at present under review, though addressed to intelligent people in general and not specifically to scientific workers, is an attempt to impose the implications of science on the social and political world of to-day. Its distinguished author, himself a scientific man turned publicist, is perhaps more fitted than any other living writer to point the moral of our present discontents and to formulate political intentions for the world of science.

This book is really a highly concentrated essence,

distilled from the author's sociological writings of the last twenty years. It looks back to the Samurai—the voluntary aristocracy of "A Modern Utopia"—and to the imagined State in "Men like Gods"—"whose education was its government." It considers and rejects the experimental anthropomorphism of "God the Invisible King", and it carries on the scepticism about democratic institutions which has marked Mr Wells's writings ever since "The New Machiavelli." It contains no new fundamental ideas, but it is mature and articulated beyond any other sociological book its author has produced, and it makes, very explicitly and with complete seriousness, a most daring proposal.

When, towards the close of the War, Mr Wells sat down to consider what mankind must do to prevent the recurrence of that colossal tragedy, he discovered that, despite a respectable array of 'qualifications', he was very much at sea about a number of things which a properly educated citizen of the world ought to know. Fortunate in the possession of leisure and opportunity, he set to work, with the help of a number of distinguished specialists, to complete his education, and the result was three very important books the writing of which has left its mark on that at present under review. "The Outline of History" sought to tell the story of mankind from the primeval lair to the Peace of Versailles. "The Science of Life" recounts what is known of biology, especially in relation to human affairs, and "The Work, Wealth, and Happiness of Mankind" deals with the ways in which humanity earns its living at the present day. These three works form together a first draft of the necessary humanistic education of the future, and in the writing of them the author's distinctive political ideas have gained clarity and precision.

The present work, which replaces an earlier sketch called "The Open Conspiracy", contains the general conclusions of this mind-clearing process. It is a plan of world reconstruction made necessary by science and conceived in the scientific spirit. It does not claim to start a new movement. It is presented as a statement of a general tendency which its author perceives in the minds of intelligent contemporaries.

Mr Wells maintains that the changes in the scale of effective human association which have been brought about by scientific discovery necessitate certain wide innovations in social structure and policy if mankind is to survive, let alone to profit fully by the possibilities which modern knowledge holds out. The realisation of these innovations, he asserts, is likely to become an

increasing preoccupation of intelligent people the world over, and in the service of these developing ideas we may hope to find expression and significance for our individual lives

To this convergence of the creative intelligence of our race upon the political problems which science has set us to solve Mr Wells gives the name of 'The Open Conspiracy', *conspiracy* because it is conceived as a revolutionary movement paying no superstitious respect to established constitutional usages, and *open* because its principal method is the frank discussion and publicly announced intention which have long been the practice of the scientific world. His proposal is that constructively-minded people should deliberately and progressively possess themselves of the nerve-centres of the world in order to establish a responsible world directorate in control of human affairs

The first necessity for the Open Conspiracy arises from the technical evolution of modern warfare. What in pre-scientific ages was a relatively harmless bickering of governments has now become a danger which threatens the very life of civilised mankind, and the sixty or seventy sovereign States, with their arms and flags and their propaganda of separatist loyalties, have proved themselves an impossible method of government in a world which every day becomes more complete in its interdependence. The Open Conspirator, therefore, will work for the ending of war in the only way whereby war can be made finally impossible: by the ending of national governments the peculiar sovereignty of which consists in their right of ultimate resort of arms

It is not only war, however, which science has rendered inadmissible in the modern world. The industrial and financial anarchy which condemns that world to penury in the presence of plenty must also give place to comprehensive and responsible direction. Our major economic concerns, such as credit, fuel, power, transport, and food, can no longer be left to chaotic competitive production on an alleged basis of profit-seeking. They must become the objects of organised production for use.

This, however, does not mean that these matters must be subject to popularly elected committees or councils or parliaments at the mercy of an ill-informed and only intermittently attentive electorate. Mr Wells maintains that real control should be in the hands of those who are sufficiently interested to exercise it seriously and competently. This control should be rendered responsible, not through elections made ridiculous by the arts of the politician, but through public criticism such as

at present prevails in the scientific world. This rather startling proposal, which breaks sharply both with political and with industrial practice in Britain, merits a much more careful examination than is possible here. It recalls certain features of the social organisation of the Soviet Union and the Italian Corporative State—neither of which can be dismissed as a mere tyranny—and is curiously paralleled by a suggestion put forward some years ago over the signature of Mr Lloyd George, that industrial concerns should be made responsible simply by the statutory publication of very full information about their activities.

In the third place, the Open Conspirator must take account of population in a way which no previous statesmanship has dared to do. He must take steps to prevent any such uncontrolled increase in numbers as would cash in mere low-grade proliferation the material abundance which science offers to mankind. It is suggested that universal knowledge of contraceptive methods, combined with quite minor changes in our social and economic arrangements, would relieve us of the present fear of over-population even in India and the East, and would also rob the practice of birth control of its dysgenic effects.

The Open Conspirator thus comes into necessary conflict with various religious and obscurantist bodies which at present seek to restrict the use of these important inventions in human biology. This, because of the value he attaches to free, abundant, and competent discussion and to the fullest diffusion of authenticated knowledge, he will in no wise regret. He will welcome also every opportunity to foster sound non-tendencious education. He will make no truce with those who seek to use the common schools to inculcate nationalism or obstructive theological dogmas, or who set up barriers against the dissemination of modern knowledge. He will work for an education which will liberate minds instead of repressing them, and will answer the natural curiosities of questing youth by telling, as completely as contemporary knowledge makes possible, the place and task of the new generation in the world-wide drama of mankind.

There is nothing essentially new about all this. The dream of a world ordered and peaceful, of mankind deliberately grasping its opportunities and rising to the measure of its great occasions, has gleamed ever and again in literature and statecraft since the Hebrew prophet spoke of nations which "should learn war no more." What is new is the sense of urgency, of an imminent choice

between world order and a disastrous retrogression from all the fine possibilities of the present day, and the conviction that a growing minority of intelligent people must add to their personal concerns an overriding solicitude about the unification of the world, must work for it and shape their careers towards it, and find in the promise of it their justification and significance L A F

### A New History of the Middle Ages

*The Middle Ages, 300-1500* By Prof James Westfall Thompson Vol 1 Pp xxx+618 Vol 2 Pp vii + 619-1069 + xlv 42s net Abridged edition Pp xii + 466 21s net (London Kegan Paul and Co, Ltd, 1931)

WE owe to an American professor what is probably the best extant account of the Middle Ages as a whole, in English and in moderate compass. Prof Westfall Thompson was a pupil of Luchaire in Paris, and no doubt it is partly due to this fact that he maintains throughout the European aspect of the medieval period, which is so essential and at the same time so rare in popular general books written on it in English. One gains quite a new and a truer point of view about almost every part of the subject—feudalism, the rise of the towns, the Hundred Years' War, Flanders and the woollen trade—if one looks at it from the centre and not from the circumference. At the same time, it must not be thought for a moment that the author is anti-English. On the contrary, he is specially strong on the part played by English—and Irish—missionaries in spreading education and civilising the West. Where one feels a lack—and it is the same in Mr H G Wells's "Outline"—is on the side of the superior English political development. It is well to know that in the earliest stage all the rising European monarchies had their 'curia regis' and the germs of a national assembly. But it is important also to realise how it came about that in England the nobles identified themselves with the national cause, whereas abroad it was left for the monarch to speak for the State. No doubt Prof Thompson is well aware of this, and he probably omits it because it is so well known to English readers. But, all the same, it is a serious lacuna.

For the rest, one has little but praise to express. The author's learning is most extensive, and he refers in full bibliographies at the end of each chapter also to the most accessible modern books. He was a considerable contributor to the "Cambridge Medieval History", and has had the great

good sense to wait until that monumental collective work was completed before offering a general conspectus from one pen and one co-ordinating mind. The difference in the effect on the reader is most marked. One only refers to the great compilations, to which we are now accustomed, in order to look up some particular point or see what one man thinks about one problem. But when a reader has once started this book, though it is well packed with facts, he is drawn on, the author is so full of his subject and so keen on its interest and importance that he holds attention from beginning to end.

Where the author fixes the beginning and where the end, are also interesting points. He begins with a sketch of the Roman Empire at the time when it was being permeated by Christianity, and his last sentence is one from Erasmus on the eve of the Reformation. "'In this part of the world,' wrote Erasmus in 1517, 'I am afraid a great revolution is impending.' He was right." From which it appears that to Prof Westfall Thompson the medieval Church is the central thread of medieval history, and he also is right.

The book should, however, commend itself specially to readers of NATURE by the due space and appreciation assigned to the intellectual development, both in physical science itself and in general philosophy. The author analyses these carefully, and by frequent quotations from George Sarton shows that he is in touch with the chief repository of such learning, certainly in the United States, if not in the whole world. He discards the contemptuous view of the scientific attainments of the Middle Ages at their best, and is at pains to show that, though the masses everywhere were subject to the wildest superstitions, individual great minds were grappling with the deepest questions and in many cases anticipated, not indeed particular physical discoveries, but profound general ideas of later date.

In this matter, the contrast which is drawn between the contributions of Germany and Italy towards the end of the period is instructive and interesting. The author holds that it is to the reflective German minds of the last centuries of the Middle Ages that one must look for the origin of the development of pure scientific thought. In Germany and not in Italy one finds the unbroken line of great scientific thinkers, from Albertus Magnus—a German count—onwards to Copernicus, a Germanised Pole. In the last part of the fifteenth century the University of Cracow was ahead of Prague or Heidelberg, and as Poland was always

in close touch with Italy, largely through the University of Padua, it was German science, via Polish scholars, that at last awakened the spirit of scientific research in Renaissance Italy in the sixteenth century. Thus Galileo comes out at the end of one apostolic succession to become the first of another, and we may realise the inter-connectedness of us all.

The rôle of Italy in art was otherwise determined and more universally operative. It still contained, after all the ravages of the barbarian wars, by far the largest collection of ancient works of art in the West, and, being in touch both with Germany through the imperial connexion and with the East through Venice and the Crusades, it served as a radiating centre for all the art-forms of the later Middle Ages. The book has a few typical illustrations of comparative churches of Romanesque and Gothic style, and an abundance of good clear maps in colour, printed in Germany.

We have picked out for notice a few of the features specially congenial to readers of *NATURE*, but it should be understood that the author himself seems to be as many-sided as history. He is particularly enlightening on the battles of the Hundred Years' War and is an expert on armour, and his account of Joan of Arc strikes us as the justest and the most poignant rendering of that immortal and yet almost unbearable story perhaps possible in half a dozen pages.

There is issued at the same time an adequate and very competently abridged edition in one volume for college use. This retains all the main features of the larger work, including its excellent maps, it is only shortened by leaving out a number of personal details and certain political and military events.

F. S. MARVIN

### Science as one of the Humanities

*The History of Science and the New Humanism*. By George Sarton. Pp 178 (New York: Henry Holt and Co., 1931). 2 dollars.

IN his recent book on "Clothes", Mr. Eric Gill says that "in our hearts we know science for what it is—the greatest frivolity of history." If it was not that science enables a lot of people to get rich it would now be what it was before—the amusing hobby of charming old fools. While this statement is no doubt intended to be deliberately provocative, it unfortunately represents—if only in caricature—the opinion of many otherwise cultured men and women, who have somewhat surprisingly failed to realise that science is as essential

ally concerned with the philosophic values and the 'eternal ideas' as any other department of human intellectual activity. As followers of science, we know that the reproach is entirely unjustifiable, but to refute it is by no means easy. The difficulty lies mainly in the fact that, while the material results of science are immediately obvious, the philosophic framework of science, its methods, its aims, and the rigorous discipline of the laboratory, are scarcely to be comprehended, or even imagined, except by those who have had some considerable personal experience of scientific work. It is, however, clearly of the first importance that, in a world for which science has opened strange new vistas, and upon which she has conferred the power of limitless exploitation of natural resources, misconceptions of the ultimate character of science and misapplications of scientific knowledge should be removed as completely as possible.

This is one of the problems that Dr. Sarton discusses in his latest book, which, though slight in bulk, is a very valuable contribution to educational thought. He regards the difference of outlook between men of letters, historians, philosophers, the "so-called humanists", on one side, and men of science on the other, as "the most ominous conflict of our time." No simple solution appears possible, but much might be done by a wider teaching of the history of science, since this affords a means of conveying to humanity the real significance of science and its cultural value, which far transcends all its applications. Dr. Sarton rightly emphasises the fact that "there are no natural sciences as opposed to humanities, every branch of science or learning is just as natural or as humane as you make it. Show the deep human interest of science and the study of it becomes the best vehicle of humanism one could devise." If, as many will agree with Dr. Sarton in believing, such a desirable result may be largely achieved by a more general inclusion of the history of science in educational schemes, it would be folly to neglect a tool that lies so ready to our hands. Much has indeed already been done, but more remains to be accomplished.

Dr. Sarton is, however, too wise to believe that misvaluation of science is confined to the humanists, or that the faults are all on one side. Though, as he rather bitterly remarks, "science teachers are not expected to impart any education, but simply to teach their own technicalities", he is by no means sure that the science teachers themselves are not partly to blame for the invidious distinction between 'scientific' and 'cultural' courses. The man of science is too often aloof, assertive, self-

righteous, and incapable of appreciating branches of study outside his own, in short, he suffers from many of the very defects he rebukes in others. The remedy that Dr Sarton would apply is again the study of history—not necessarily the history of science alone, though a modicum of the latter is essential. He would like to see a solid literary and artistic basis and an insistence on the historical point of view in all scientific education, while the more literary-minded students would receive frequent explanations of scientific methods by men familiar with the history of science.

The main theme of the book is, indeed, a plea for a true cultural synthesis as the best help for the present and the most hopeful prospect for the future. The unity of mankind, as it emerges from a study of the development of civilisation in all its aspects, is the lesson the teacher should strive to impart, and though there must be specialists, there should be no specialist unaware of the unity of knowledge and unappreciative of the work of others.

Dr Sarton is concerned with more than generalities and vague indications of the path to be followed. He supports his thesis with detailed suggestions for educational schemes, and since these are both practicable and most carefully thought out, they demand the serious consideration of everyone who has the intellectual welfare of the race at heart. To humanise knowledge and to integrate it must be the earnest desire of every reflective man, and Dr Sarton has shown us how that desire might be accomplished.

E J HOLMYARD

### Short Reviews

*Catalogue of Latin and Vernacular Alchemical Manuscripts in Great Britain and Ireland dating from before the XVI Century* By Dorothea Waley Singer, assisted by Annie Anderson and by Robina Addis. Vol. 3. Pp. iii+757-1179. (Brussels: Union Académique Internationale, 1931.) 15 Belgas.

THE third volume of Mrs Singer's monumental catalogue of alchemical manuscripts in the British Isles mainly consists of indexes, with corrections and addenda to earlier descriptions. The indexes comprise a list of first lines of every tract described in the catalogue—a feature of the greatest use to students in every country, a list of every person, whether author, scribe, or owner, mentioned in them, and a list of the manuscripts classified under the libraries where they are to be seen, and containing much incidental information concerning them. In brief, nothing has been neglected which could make the work more valuable to those likely to use it, and Mrs Singer is to be congratulated heartily on so complete a piece of work.

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Two sections are prefixed to the book, the first dealing with a curious work known as *Kyrannides*, just over the border-line between alchemy and magic, the second dealing with legal documents on its history. Of these, one is specially interesting as bearing on a legend preserved by Camden in his "Remaines concerning Britaine", where he says of the first gold noble, coined by Edward III. of pure gold in 1343 or soon after, "which our Alchemists do affirm (as an unwritten verity) was made by projection or multiplication Alchimicale of Raymond Lully in the Tower of London." In 1350, four prisoners were brought into the King's Bench from the Tower. One of them, who had been in prison for seven and a half years, had received 500 écus of gold and twenty pounds of silver from the Treasury to make gold by alchemy. There can be no doubt that this was the foundation of the Lully legend.

Another interesting entry is that of a very strong Royal Commission in 1457 to examine and report on the merits of alchemy and the elixir. Its report has never been found, but it is not impossible that it still lies somewhere in the Record Office. As gold-making was illegal, and continued to be so until 1689, a number of licences to practise the art were granted. The number of manuscripts in fifteenth century English testifies to a wide interest in the subject. It is a curious chapter in the history of science.

R. S.

*The Physiology of Beauty* By Arthur Sewell. Pp. xiv+194. (London: Kegan Paul and Co., Ltd., 1931.) 8s 6d net.

THE modern mechanist—the 'publicist', to adopt the term used by Prof. Hogben, who contributes an introduction to this book—has never claimed that all the activities of living matter are to-day capable of being 'explained' on physico-chemical lines, or even that they ever will be. But he does hold it to be possible, and even likely, that the behaviour of living organisms will one day be describable in the same terms, by means of the same symbols, and in the light of the same laws as are available to describe the phenomena of the inorganic world.

The possibility of applying to æsthetic responses any methods of analysis comparable with those used in pure science has in general been ridiculed by the anti-mechanists.

To the best of our knowledge, Mr Sewell is the first to attempt, in anything like a systematic manner, to apply to these responses the ideas of behaviourist philosophy and the concept of the conditioned reflex. He has done so with courage, humour, knowledge, and, so far as the complexity of his subject permitted, remarkable lucidity. Perhaps a disproportionate section of his book is devoted to discussing the "physiology of truth" and the "physiology of good", at the expense of the actual subject promised by his title. This is analysed in Part IV, but with such tantalising brevity that another book in which ethics and epistemology have a relatively much smaller share is much to be hoped for, so that he may further

develop the idea of "biological utility" in æsthetic responses and his purely extrospective technique.

Those who are emotionally anti-mechanist, who have been conditioned against even sympathy with the publicist attitude, will do well to ignore this book. It is difficult to see how they will be able to reply to much of it. But those who realise that their enjoyment of poetry, painting, music, and the other arts will in no wise be impaired by correct analysis of that enjoyment, and who prefer an objective to an introspective analysis, should welcome the publication of Mr Sewell's book.

A. L. B.

*The House of Industry a New Estate of the Realm*

By S. G. Hobson. Pp. xxviii + 113. (London: P. S. King and Son, Ltd., 1931.) 1s.

SUPERFICIALLY "The House of Industry" is but another name for the House of Lords, become the chief cornerstone in the logical evolution of the ever-increasing tendency of the House of Commons to turn its economic problems over to independent 'commissions' for solution. Actually it is a British version of the Soviet Central Committee.

In his effort to make the suggestion palatable to a people to whom property rights are regarded as sacred, Mr Hobson has left several unbridged gaps between the idea and its practical application. The House of Industry is a new name for a metamorphosed House of Lords, but the House of Industry is to be partly selected and partly elected "by groups differently graded in the industrial hierarchy". How are the groups to be graded? Who is to grade them? How will the selection and election be carried out? He does not say, nor how he will ensure the selection and election of men competent to handle economic problems. As to how the peers and people are to be convinced that the elected-selected House of Industry is in apostolic succession to the hereditary House of Lords, he is also vague.

However, concede the House of Industry established: it must be stable, with no interest beyond the needs of industry (including the worker). A selected body might be so—the judiciary is beyond reproach—but can the elected portion ever be free from the influence of its electors? And if so, why elect?

To ensure efficiency, the House of Industry is to be free of the technicalities intended to safeguard democracy, but it is to be subject to the veto of the Commons, which will remain subject to those technicalities.

The idea is interesting. It is ably advocated. But is it sound? One is not yet convinced.

*Grundprobleme der Geologie eine Einführung in geologisches Denken*. Von Prof. Siegfried von Bubnoff. Pp. viii + 237. (Berlin: Gebrüder Borntraeger, 1931.) 11.60 gold marks.

THE flood of German geological literature that began after the War continues to rise so rapidly that many worthy contributions must perforce be given scant attention by geologists to whose special interests they do not immediately refer. It is

therefore important to insist upon the outstanding virtues of this short but brilliant book by Prof. von Bubnoff. As a philosophical treatment of the methods and fundamental problems of geology it is unsurpassed, and it is not too much to say that no geologist, be he practitioner, teacher, or advanced student, could fail to profit from a careful reading of this stimulating, clearly expressed, and fair-minded survey of his subject.

Prof. Bubnoff's style is lucid and his vocabulary can be quickly mastered; his German presents no terrors and need not deter even those who usually struggle along with difficulty. The book will richly repay a sustained effort to master its contents. The first part deals with the epistemological basis of geology, the second with the interpretation of the rocky pages of the earth's long history, the third with the measurement of geological time, the fourth with the tectonic conceptions embodied in such terms as shields, stable shelves and mobile shelves, and geosynclines, and the fifth with the structure of the earth and its crustal movements. The present state of our knowledge of sedimentation, igneous activity, metamorphism, mountain-building, isostasy, and continental drift is expressed with admirable detachment from particular doctrines. Modern theories are ably discussed and critically analysed with equal emphasis on their successes and failures. There is a tendency to favour internal mobility as the cause of crustal movements on the lines suggested by Ampferer and Schwinner on the Continent and by Bull and Holmes in Great Britain, but with a cool recognition that the problems involved are still far from being satisfactorily solved.

The book is of quite unique value. Nothing like it in scope and temper has hitherto appeared, and an English translation would undoubtedly be very widely welcomed.

*The Genesis of Cancer*. By W. Sampson Handley. (The Anglo-French Library of Medical and Biological Science.) Pp. xix + 258 + 88 plates. (London: Kegan Paul and Co., Ltd., 1931.) 21s. net.

MR. SAMPSON HANDLEY draws his data from the experiences of a curious and progressive practical surgeon, and is concerned to define the anatomical conditions which underlie the beginnings of cancers. He finds that the feature which is common to all precancerous states is an inflammation of the smaller and mostly terminal lymphatics, leading to lymph stasis, and he upholds his thesis by the detailed histology of a considerable variety of lesions—warts and adenomata, lupus and its malignant development, chronic mastitis, skin irritation in general, especially dermatoses from tar and oil, X-rays, and radium.

The changes in the connective tissue which Mr. Handley describes are, of course, well known. He differs from most other observers in judging that they precede rather than follow cancer, and adduces much striking evidence in favour of his contention. Why exactly chronic lymph stasis should lead to cancer, he does not explain. At the moment, it is scarcely reasonable to expect him to do so.



## The Expanding Universe\*

By SIR ARTHUR EDDINGTON, F R S

IN recent years the line-of-sight velocities of about ninety of the spiral nebulae have been measured. The distances of some of the nearest of them have been determined by a fairly trustworthy method, and for others rude estimates depending on statistical methods are available. When we survey these data, a remarkable state of affairs is revealed. The spiral nebulae are almost unanimously running away from us, moreover, the greater the distance the greater the speed of recession. The law of increase is found to be fairly regular, the speed being simply proportional to the distance. The progression has been traced up to a distance of more than 100 million light-years, where the recession is 20,000 km per sec—about the speed of an  $\alpha$ -particle.

At first sight this looks as though the spiral nebulae had a rather pointed aversion to our society, but a little consideration will show that the phenomenon is merely a uniform dilation of the system and is not specially directed at us. If this room were suddenly to expand to twice its present size, the seats separating in proportion, you would notice that everyone in the room had moved away from *you*. Your neighbour who was 3 feet away has become 6 feet away, the man over yonder who was 20 feet away is now 40 feet away. Each has moved proportionately to his distance from you, which is precisely what the spiral nebulae are observed to be doing. The motion is not directed from any one centre, but is a general expansion, such that each individual observes every other individual to be receding.

In 1917, before any hint of this phenomenon had been obtained from observation, Prof. W de Sitter was on the look out for something of the kind. He found that, on one of two alternative hypotheses arising out of Einstein's relativity theory, the light of very remote objects should be displaced to the red as though they were moving away from us, and he suggested the observed motions of the spiral nebulae (by far the most remote objects known) as a discriminating test. At that time, only three radial velocities had been published, and they rather lamely supported his hypothesis by a majority of 2 to 1. The majority has now become about 85 to 5, and the five exceptions are nebulae close to us which in any case should have had only small receding velocities. De Sitter's theory has been developed and modified by Friedman and Lemaître, the modern view of it is as follows.

Einstein's law of gravitation contains a term called the 'cosmical term' which is extremely small in ordinary applications to the solar system, etc., and is generally neglected. The term, however, actually represents a repulsive force directly proportional to the distance, so that however small it may be in ordinary applications, if we go

to distances sufficiently great it must ultimately become important. It is this cosmical repulsion which is, we believe, the cause of the expansion of the great system of the nebulae. The repulsion may be to some extent counterbalanced by the ordinary gravitational attraction of the nebulae on one another. This countervailing attraction will become weaker as the expansion increases and the nebulae become farther apart. It seems likely that the universe started with a balance between gravitational attraction and cosmical repulsion, this equilibrium state is called an 'Einstein universe'. But it can be shown that the Einstein universe is unstable, and the slightest disturbance will cause either the repulsion or the gravitation to gain the upper hand, so as to topple the system into a state of continually increasing expansion or continually increasing contraction. Apparently, expansion won the initial struggle, and as the nebulae spread apart, the opposition of gravitation became less and less, until now it is comparatively insignificant.

We see, then, that according to observation the system of the spiral nebulae is expanding, and that relativity theory had foreseen just such an expansion (except that as an alternative it would have been content with an equally regular contraction). What better agreement could we desire? Nevertheless, there were some misgivings which I would not by any means condemn as unreasonable. It is true that theory predicted an effect of the kind observed, but it did not say how rapid the expansion would be. It expressed it in terms of an unknown 'cosmical constant'  $\lambda$ , leaving  $\lambda$  to be determined by observation. Now the rate of expansion indicated by observation comes to us as a great shock. The universe is expanding so as to double its dimensions every 1300 million years, that is no more than the period of geological time. Astronomers, who had been picturing a slow evolution of the stars extending over billions of years, would scarcely believe our staid old universe capable of such a hustle. In fact, it means a cut of something like ninety-nine per cent in our time-scale, which even in these days of economy cuts is not to be accepted lightly by the department concerned. For this reason many have thought that the receding motions of the spiral nebulae cannot be accepted as genuine, and that the whole phenomenon must be explained away as a misinterpretation of the red-shift observed in their spectra.

I think, however, that we shall have to accept the expansion. My reason is that it now seems possible to calculate the cosmical constant  $\lambda$  by pure physical theory. The value is the same as that given by the recession of the nebulae, so that there is full confirmation.

I have been tracing the effects of the cosmical constant in the behaviour of the great system of galaxies—phenomena on the grandest scale we

\* Friday evening discourse delivered at the Royal Institution on Jan 22

have yet imagined. Now I want to turn to the other end of the scale and look into the interior of the atom, where, I think, we shall find that the same cosmical constant turns up again. It is, in fact, the main key to the mystery of protons and electrons. I cannot go very far into this part of the theory, but I will try to show why I am convinced that the cosmical constant comes into the theory of the atom. I must premise one thing. It is well known that, in Einstein's theory, gravitation has an interpretation not only as a force but also as a geometrical property—a curvature—of space-time. So also the cosmical constant has an interpretation not only in terms of repulsive force but also as a measure of curvature. The constant  $\lambda$  is, in fact, precisely equal to  $1/R^2$ ,  $R$  being the radius of the world in the equilibrium (Einstein) state from which we suppose it to have started.

Length is necessarily relative. That is one of the results of Einstein's theory which has become almost a commonplace of physics, but it was a rather complicated kind of relativity that Einstein considered—relativity to the motion of our frame of reference. I am going to refer to another much more elementary relativity of length, namely, that length always implies comparison with a standard of length. It is only the ratio of lengths that enters into our experience. Suppose that every length and every distance in the universe were suddenly to be doubled, nothing would seem altered. I do not think we could attach any meaning to the change. Intrinsically, Brobdingnag and Lilliput are precisely the same, it needs an intruding Gulliver—an extraneous standard of length—to make them appear different.

Now, it is commonly stated in physics that all normal hydrogen atoms have the same size, or have the same spread of electric charge. We have a very fundamental equation (the wave equation) determining the spread, which is supposed to apply to any hydrogen atom and, of course, gives the same result for all. But what do we mean by their having the same size? Or it may be better to put the question negatively—What would it mean if we said that two hydrogen atoms were of different sizes, that is, similarly constructed but on different scales? It would be Brobdingnag and Lilliput over again. To give any meaning to the difference, we need a Gulliver. Now, the Gulliver of physics is always supposed to be a certain bar of metal called the International Metre. He is anything but a traveller, I think he has never been away from Paris. It was Prof Weyl who first directed attention to the very big hiatus involved, when we speak of a length such as the radius of a hydrogen atom being a certain fraction of the standard metre. We have, as it were, our Gulliver but have left out his travels. The travels are (as Weyl showed) the interesting part of the story, and are not to be glossed over as irrelevant.

Weyl went further and pointed out that there is a natural standard of comparison which is always on the spot, namely, the radius of curvature of the world *at that spot*. We can thus give a direct meaning to the statement that two hydrogen atoms in

any part of the universe have the same size, we mean that each of them is the same fraction of the radius of curvature of space-time at the place where it lies. The atom here is a particular fraction of the radius of curvature here, the atom on Sirius is the same fraction of the radius of curvature at Sirius. Whether the radius of curvature here is the same as at Sirius does not arise, and I do not think there is any meaning in trying to compare them.

The above definition of equality, and the use of Weyl's standard, may seem a dangerous innovation, but, indirectly, we have been using it all along, without knowing that we were doing so. Some years ago I pointed out that Einstein's law of gravitation can be stated in the form, "What we call a metre at any place and in any direction is a constant fraction of the radius of curvature of space-time for that place and direction." That is simply a translation of the law from symbols into words. The law is verified by observation, so that the statement gives us not only an ideal definition of the metre but also one which we know will accord with the reckoning of metres that is actually used. Thus, measurement in terms of the metre is equivalent to measurement in terms of the world radius, since the two standards are always in a constant ratio. Practically, it is more convenient to employ the metre, but in pursuing the theory we must go direct to the world radius, for obviously a particular bar of metal at Paris can have no fundamental status in physics and is altogether irrelevant to equations describing the mechanism of the atom. The world curvature, on the other hand, is on the spot and is directly reacting with the atom.

I now return to the wave equation which professes to determine how large an atom will be. That, as we have seen, means that it finds the ratio of the various intervals in the atom to the world radius there, so the world radius must come into the equation. But the world radius is the cosmical constant in another form. The cosmical constant has cropped up again inside the atom.

My task now was to spot the cosmical constant or the world radius in the current form of the wave equation, which is known by experiment to be substantially correct. It is very much disguised, because the current equation introduces the standard metre and all sorts of irrelevancies. But one knows the sort of effect that curvature can have, and the way it will appear in the equation is pretty well dictated by the quantum laws, which make a speciality of the properties of 'closed circuits' such as are introduced by curved space. I think I succeeded, and I arrived at the identification

$$mc^2/e^2 = \sqrt{N/R}$$

The left side is a term in the current wave equation, and its value is known experimentally. The right side is the way that we write it now that we have penetrated its disguise.  $R$  is the Einstein radius of the world, equal to the inverse square root of the cosmical constant,  $N$  is the number of electrons (or protons) in the universe.

This additional equation, combined with other equations already known, gives all the information required. We deduce, for example, that the number of electrons in the universe is  $1.29 \times 10^{79}$ , and that the original radius of the universe, before it started to expand, was 1070 million light-years. Most important of all, we find that the consequent rate of expansion of the universe is 528 km per sec per megaparsec distance. The observational determinations from the recession of the spiral nebulae (which might be a little lower, since they include any countervailing gravitational attraction) range from 430 km to 550 km per sec per megaparsec. We can feel little doubt, therefore, that the observed motions of the nebulae are genuine and represent the expansion effect predicted by relativity. We must reconcile ourselves to this alarming rate of expansion, which plays havoc with older ideas as to the time-scale.

However interesting may be the application of this theory to the universe, the application to the interior of the atom seems likely to be still more fruitful. Now that we know the magnitude of the

radius of curvature, we can set aside the arbitrary metre and use this natural unit in our equations. The big uninformative coefficients disappear, and the equations are so much simplified that, I think, I have a fair idea of what they really mean and how they work. In particular, the relation of the proton to the electron is now apparent, and the theoretical ratio of their masses is found to be  $1847.6$ , this is certainly very near to the observed value.

I do not want to stress too much the accuracy or finality of these first results. I cannot see how anything can possibly be wrong with them, but then one never does see these faults until some new circumstance arises or some ingenious person comes forward to show us how blind we have been. At least, a way of progress has been found. I think that some day, when electrons and protons have come to order, we shall look back and see that the key to the mystery was lying somewhere in intergalactic space and was picked up by astronomers who measured the velocities and distances of nebulae ten million light-years away.

### Goethe as Biologist

By Prof. F. J. COLE, F.R.S., University of Reading

THE celebration of the centenary of the death of Goethe, which occurred on March 22, 1832, has evoked a series of works dealing with the activities of that unique genius. Among them is a critical biography by Prof. J. G. Robertson, the eminent authority on the life and works of Goethe.\* This treatise is outside the scope, but not indeed outside the interests, of a scientific journal such as NATURE, except for the fact that it includes an enlightening chapter on Goethe's contributions to science. As a matter of personal history Prof. Robertson can scarcely be expected to take other than a detached view of Goethe's scientific achievements, and it is therefore not surprising to find him stating that "we look to Goethe, not for scientific discovery, an activity with which many other minds were as able—and perhaps better able—to cope successfully, but to more precious discoveries in the realm of the spirit and the imagination. May we not thus cherish something of a grudge that his immersion in scientific pursuits took up so very large a share in his life?" Prof. Robertson, however, would be the first to admit that Goethe himself would have indignantly denounced such an attitude, which strikes at the root of one of his characteristic speculations as to the nature of creative art. To him the living organism was a work of art which only an artist could be expected to comprehend. Further, it is precisely those attributes of the spirit and imagination which give to his scientific work the qualities we all find so fascinating.

It was in an essay written in 1795, but not published until 1820, that Goethe focused attention on the unity of plan or organic constant which was

supposed to underlie the organisation of all living beings. Since there was only one plan or idea, the world was regarded as something akin to a vast musical symposium, in which the poverty of a solitary theme was enriched by an endless and expanding series of variations. All forms were interpreted in terms of this ideal simulacrum,† and even man himself must be studied comparatively, working downwards from higher to lower types. This is the so-called law of reduction, or, to paraphrase the words of Geoffroy—there is but a single intangible being which becomes patent to our senses under diverse forms. Goethe was, of course, not the first to adopt such an attitude, but he was the first to convert it into an ordered scientific theory. The plan was put into operation or integrated by a controlling dynamic principle or *Bildungstrieb*. It is obvious at the outset that the theory is a scheme of development and not a principle of evolution, and, further, that its working out must depend on the institution of a system of homologies. There is one attractive feature in this point of view. However wrong it may be, it attempts to provide a common explanation of organic phenomena, and does not countenance the artificial separation of animals and plants.

Goethe's eager pursuit of homologies, of uniformity in diversity, was bound to lead to the conception that there was only one animal. Not merely was there a single animal type, but the integration of the type itself was effected by linking up into a series a number of similar, complete, subordinate entities like a string of beads. He extended the same speculation to plants, and interpreted, as others had done before him, the

\* "The Life and Work of Goethe, 1749–1832." By Prof. J. G. Robertson. Pp. xii+350+8 plates. (London: George Routledge and Sons, Ltd., 1932.) 12s. 6d. net.

† Goethe would not have approved this term, but the 'reality' of the idea is that of a mental abstraction projected on to paper like Owen's Archetype.

leaves, sepals, petals, stamens, and pistils as variants of a common structure, just as the skull of the animal represented the efflorescence of the vertebral column. Leaf and vertebra were the elemental structures of animal and plant. He was not unmindful of the fact that modifications of the plan cannot be introduced without affecting the status of the whole, and his law of balance, that "in order to spend on one side, Nature is forced to economise on the other side", is closely related to the famous deduction made by Cuvier in 1812 of the law of correlation, which was exploited with such dramatic effect by himself and later comparative anatomists. Goethe was not the only biologist to become obsessed with this idealistic morphology. Even Johannes Müller himself embodied it in his "Inaugural Dissertation"—a lapse which this sensitive man lamented so deeply in later years that he bought up and destroyed all copies of the offending thesis.

It is not difficult to understand why Haeckel should have been led to credit Goethe with a share in the triumph of evolution, and to regard him as a forerunner of Darwin. Both Haeckel and Goethe were convinced upholders of the comparative method, and Haeckel was powerfully influenced by the genius of the poet. In Goethe's work on the metamorphosis of plants published in 1790, which is considered to be the beginning of speculative morphology,\* there are passages which give some support to the claim. Everything depends on his interpretation of what is called 'metamorphosis'. Is it an objective historical reality, as any principle of organic evolution is considered to be, or is it a philosophical conception expressing nothing more than the realisation of a generalised subjective plan or idea, which itself is not inconsistent with Nature philosophy and special creation? He hesitates between these alternatives, nor does it appear that they were ever sharply contrasted in his own mind, and he has no consistent views with regard to either. His contemporaries included him among the Nature philosophers, and Goethe, who did not hesitate to express the liveliest dissatisfaction when his scientific works were misunderstood, never thought it worth while to correct them. In his later writings, however, he appears at times to have a clearer perception of the evolutionary alternative, but again, at the close of his life, in 1830, he was supporting Geoffroy in his contest with Cuvier, which shows how far he was from comprehending the historical implications of evolution. There is no evidence that he ever specifically discussed the problem of species, regarding such speculations as "a useless occupation which we may well leave to those who are fond of busying themselves with insoluble problems" (Robertson).

The main point of contact between Goethe and Haeckel lies, however, in the fact that the evolutionist, like the Nature philosopher, also expects to find uniformity in diversity, but he only looks for it where it may reasonably be expected to

exist, nor is he in any way constrained to mould the facts or stretch the argument in those cases where the quest has been unsuccessful. Failure must not only be expected but also accepted, since it does not affect the essential truth of the principle of evolution, but merely its mode of operation. Whilst, therefore, Goethe's methods were up to a point those approved by Haeckel and the evolutionists, he goes, and must go, considerably beyond the permitted limits of scientific induction. Having assumed the existence of a single animal type, it follows that, unless evidence for such a type be forthcoming, every species must be manipulated to conform to it. Such was the error of Goethe and his successors the Nature philosophers, and it must be held definitely to exclude them from the evolutionary circle, although Goethe himself was never guilty of the ludicrous extravagances of his disciples. In one cardinal respect, however, he was remarkably sound. He saw that purely morphological speculation was as dust and ashes in the mouth compared with the vision of the form and activities of an animal as a living organic whole. Or in other words, the *complete* organism only can give us understanding of its inner meaning or idea.

The attitude adopted by Goethe towards the question of animal relationships may be profitably explored by a comparison of his two researches on the intermaxillary bone and the vertebral theory of the skull. The former was written up in 1784 and bears the date of 1786 (*sic*),† but it was not published until 1831, although an abstract without illustrations appeared in 1817. The latter paper was drafted and communicated to friends in 1790, but was actually published in 1820, this belated publication being responsible for the priority dispute with Oken. The alleged absence of the premaxilla in man was considered to separate him definitely from the apes—a conclusion which ignored the fact that if the bone is absent in man it is also wanting in the higher apes. Goethe sought to establish its presence in man by methods not dissimilar from those of the modern comparative anatomist. He examined its condition in a number of mammals, noted variations in its state of development and correlated them with feeding habits, investigated aberrant cases such as that of the elephant, and succeeded in finding the bone in some species in which it had not been described. Finally, by comparing human adult and foetal skulls, he demonstrated its presence in man ‡. He thus established the importance of embryology in the interpretation of adult structure. His work, in fact, is an admirable essay in comparative anatomy.

The research on the skull, however, belongs to another category. It has no concern with experience, but is an exploitation of the Idea. Whether the skull is vertebral in nature or not, cannot be tested by observation. If, however, we concede the point, the skull may have been formed on the

\* Goethe introduced the term morphology in 1817, but his definition of it is not retained in modern usage.

† This date is usually but erroneously quoted as the date of publication.

‡ The bone was not first discovered in man by Goethe. Vesalius and Fallopius saw indications of it in 1543 and 1561, and Vicq D'Azyr described it in the human foetus in 1780-84.

vertebral pattern as the result of the operation of a creative force working according to plan, or it may have been produced from modified vertebrae by a process of evolution. In either event, the investigator is confronted with an abstraction beyond the means of verification. It is otherwise with the case of the intermaxillary bone. Here the 'metamorphosis' may be tested and observed in all its stages, and an evolutionary conclusion becomes not only possible but almost inevitable. But how did Goethe regard these two problems? To him their implications and significance were identical, and the only inference he drew from both of them was a confirmation of his theory of the common plan or idea. To such an outlook, deduction and induction are indistinguishable. Had the history of the intermaxillary bone suggested to his mind any conception of genetic relationships, he would surely have said so. Goethe

therefore was a forerunner of Darwin only in the sense that before the historical continuity of species could be established it was necessary to formulate a doctrine of homologies, and in this important work Goethe played a leading part.

Not until the end of his life did Goethe exercise any appreciable influence on the biological thought of the period. This was due partly to delays in publication, but particularly to the imaginative and romantic character of his work—a quality rarely grateful to the academic mind. At first his influence was almost wholly reactionary, but the eclipse of Nature philosophy purged his writings of their ephemeral content and made it possible to form a sound judgment of the residue, with results that have only become evident in modern times. That his biological work will always command the respect and admiration of scientific men is a conclusion to which all his critics would assent.

### Goethe's Reflections on Nature

WE reproduce below the translation of Goethe's reflections on Nature by T. H. Huxley, which was published as an introductory article to the first number of *NATURE*, dated Nov. 4, 1869. As originally printed, a casual reader might easily conclude that this lyrical composition was the work of Huxley himself, and in a letter to Dohrn, written shortly afterwards, he says "It astonishes the British Philistines not a little. When they began to read it they thought it was mine, and that I had suddenly gone mad." Darwin himself was stirred to admiration, and wrote to Hooker as follows: "Lord, what a rhapsody that was of Goethe, but how well translated, it seemed to me, as I told Huxley, as if written by the maddest English scholar. It is poetry, and can I say anything more severe?" Huxley added to his translation some comments upon Goethe's "wonderful rhapsody on Nature which has been a delight to me from my youth up", and he referred to it in an article entitled "Past and Present", contributed by him to the first issue of our fifty-first volume, on Nov. 1, 1894. In a footnote to this article, Huxley said: "A better translation than mine and an interesting account of the very curious obscurity which hangs about the parentage of *Die Natur* are to be found in Mr. J. Bailey Saunders' recently published 'Goethe's Aphorisms and Reflections'."

#### NATURE APHORISMS BY GOETHE \*

NATURE! We are surrounded and embraced by her powerless to separate ourselves from her, and powerless to penetrate beyond her.

Without asking, or warning, she snatches us up into her circling dance, and whirls us on until we are tired and drop from her arms.

She is ever shaping new forms what is, has never yet been, what has been, comes not again. Everything is new, and yet nought but the old.

We live in her midst and know her not. She is incessantly speaking to us, but betrays not her secret. We constantly act upon her, and yet have no power over her.

\* From *NATURE*, Nov. 4, 1869.

The one thing she seems to aim at is Individuality, yet she cares nothing for individuals. She is always building up and destroying, but her workshop is inaccessible.

Her life is in her children, but where is the mother? She is the only artist, working up the most uniform material into utter opposites, arriving, without a trace of effort, at perfection, at the most exact precision, though always veiled under a certain softness.

Each of her works has an essence of its own, each of her phenomena a special characterisation and yet their diversity is in unity.

She performs a play, we know not whether she sees it herself, and yet she acts for us, the lookers-on.

Incessant life, development, and movement are in her, but she advances not. She changes for ever and ever, and rests not a moment. Quietude is inconceivable to her, and she has laid her curse upon rest. She is firm. Her steps are measured, her exceptions rare, her laws unchangeable.

She has always thought and always thinks, though not as a man, but as Nature. She broods over an all-comprehending idea, which no searching can find out.

Mankind dwell in her and she in them. With all men she plays a game for love, and rejoices the more they win. With many, her moves are so hidden, that the game is over before they know it.

That which is most unnatural is still Nature, the stupidest philistinism has a touch of her genius. Whoso cannot see her everywhere, sees her nowhere rightly.

She loves herself, and her innumerable eyes and affections are fixed upon herself. She has divided herself that she may be her own delight. She causes an endless succession of new capacities for enjoyment to spring up, that her insatiable sympathy may be assuaged.

She rejoices in illusion. Whoso destroys it in himself and others, him she punishes with the sternest tyranny. Whoso follows her in faith, him she takes as a child to her bosom.

Her children are numberless. To none is she altogether miserly, but she has her favourites, on whom she squanders much, and for whom she makes great sacrifices. Over greatness she spreads her shield.

She tosses her creatures out of nothingness, and tells them not whence they came, nor whither they go. It is their business to run, she knows the road.

Her mechanism has few springs—but they never wear out, are always active and manifold

The spectacle of Nature is always new, for she is always renewing the spectators Life is her most exquisite invention, and death is her expert contrivance to get plenty of life

She wraps man in darkness, and makes him for ever long for light She creates him dependent upon the earth, dull and heavy, and yet is always shaking him until he attempts to soar above it

She creates needs because she loves action Wondrous that she produces all this action so easily Every need is a benefit, swiftly satisfied, swiftly renewed—Every fresh want is a new source of pleasure, but she soon reaches an equilibrium

Every instant she commences an immense journey, and every instant she has reached her goal

She is vanity of vanities, but not to us, to whom she has made herself of the greatest importance She allows every child to play tricks with her, every fool to have judgment upon her, thousands to walk stupidly over her and see nothing, and takes her pleasure and finds her account in them all

We obey her laws even when we rebel against them, we work with her even when we desire to work against her

She makes every gift a benefit by causing us to want it She delays, that we may desire her, she hastens, that we may not weary of her

She has neither language nor discourse, but she creates tongues and hearts, by which she feels and speaks

Her crown is love Through love alone dare we come near her She separates all existences, and all tend to intermingle She has isolated all things in order that all may approach one another She holds a couple of draughts from the cup of love to be fair payment for the pains of a lifetime

She is all things She rewards herself and punishes herself, is her own joy and her own misery She is rough and tender, lovely and hateful, powerless and omnipotent She is an eternal present Past and future are unknown to her The present is her eternity She is beneficent I praise her and all her works She is silent and wise

No explanation is wrung from her, no present won from her, which she does not give freely She is cunning, but for good ends, and it is best not to notice her tricks

She is complete, but never finished As she works now, so can she always work Everyone sees her in his own fashion She hides under a thousand names and phrases, and is always the same She has brought me here and will also lead me away I trust her She may scold me, but she will not hate her work It was not I who spoke of her No! What is false and what is true, she has spoken it all The fault, the merit, is all hers

## Obituary

DR G CLARIDGE DRUCE, FRS

THE death on Feb 29, at Oxford, of Dr George Claridge Druce removes not only the best-known student of our British flora but also a remarkable personality The charming story of his early life, which he has given us in the introduction to his "Flora of Buckinghamshire", shows how circumstances worked to shape his life and mould his character He was born on May 23, 1850 The *res angustae* of his childhood threw him into the arms of Nature for his diversion, and his playthings were the wild flowers around the Northamptonshire village where his widowed mother had made her home He tells how, by the lack of foresight of his guardian, he was debarred from a public school education, but the individuality which characterised his work through life, his independence, his undaunted persistence in arriving where others would have fallen short, may perhaps be traced to the less rigid training of his early years In the woodlands near his home he studied the insect life as well as the plants, and by the age of fourteen had made a very representative collection of the local Lepidoptera, pupæ were dug for and larvæ bred, and plants were fixed in the memory by making carbon impressions of the leaves Holidays spent in different localities in Bedfordshire on the greensand and chalk enlarged his knowledge of the flora and insect life

At fifteen Druce was apprenticed to a large wholesale and retail chemist's business in Northampton, and two years later became acting-manager The long business hours left little time for field-work, much of which was done by rising at 5.30 or 6 A.M. During the years that followed, without tutorial aid, he studied for and passed

with honours the examinations for a pharmaceutical chemist A herbarium was indicated as part of the equipment of a pharmacist, in 1873 one was begun, and in the first year he collected about 750 species He was now definitely working on the preparation of a "Flora of Northamptonshire", which was printed in 1879 in the *Journal of the Northamptonshire Natural History Society*, of which he was one of the founders and had also acted as honorary secretary and president His last important piece of work was a much enlarged and fuller "Flora" of his native county, published in 1930

In 1879 Druce bought, with his savings, the pharmacy in High Street, Oxford, where he remained in business for the rest of his life Prominent landmarks of subsequent years are the "Floras" of the Thames valley counties, at which he worked successively—Oxfordshire (1886), Berkshire (1897), and Buckinghamshire (1926) But the preparation of these county floras by no means represented the sum of his botanical work No man had so intimate a personal knowledge of the British flora, which had been gained by frequent excursions to all parts of the country The fact that a 'new' plant had been reported in Skye or some other locality, near or remote, was enough to send him hot-foot in search of it, and the Annual Reports of the Botanical Society and Exchange Club, which, as secretary, he has drawn up since 1904, are replete with new records and critical notes on British plants by himself and other botanists The Botanical Society of the British Isles, which Druce started in 1908 as an appendage to the Exchange Club to enlist the help of well-wishers as well as of active workers, did



much to popularise British botany. The Report for 1930, issued last August, after his eightieth birthday, is a testimony to his remarkable energy and virility, recording, as it does, excursions to widely distant parts of the British Isles and a visit to Cyprus.

Not the least interesting fact in Druce's career was his association with the University of the city in which he had his business. Oxford accepted him and honoured him. A botanist visiting a University official (not on the science side) was asked, "You know *our* botanist—Mr. Druce?" In 1895 he was appointed Curator of the Fielding Herbarium and attached to Magdalen College with an honorary M.A. degree. Many years later he was awarded the D.Sc. In association with the professor of botany, Dr. S. H. Vines, he published accounts of two of the historic Oxford Herbaria, the Dillenian in 1907, and the Morisonian in 1919.

Druce's botanical travels were not confined to the British Isles. He had a good personal acquaintance with the European flora, especially of the Mediterranean area. In 1914 he was in Australia with the British Association, and he had also visited South America.

Druce was a good citizen—a member of the City Council, sheriff (1897), and mayor (1900). He had also served as president of the British Pharmaceutical Conference. Writers in the public press have borne testimony to his unsparing readiness to advise and help students of the British flora, however humble, and his wide circle of friends and the remarkable response to the memorial presented on his eightieth birthday testified to the esteem and affection in which he was held. Druce had his foibles. He dearly loved a title. He did not

scruple to strain a point to enable him to write *mihi* after a plant-name. His handwriting was execrable. A regrettable and life-long quarrel arose partly from an honest but unsuccessful attempt by an editor to transliterate a botanical communication from him. He had the true collector's spirit—the impulse to get in first.

A remarkable man, Druce has made a noteworthy contribution to British botany by his personal influence, by his published floristic works, and by the rich herbarium and library which he has left with his house and an endowment as a Botanical Institute for the use of botanists. His election to the fellowship of the Royal Society in 1927 was a graceful and appropriate recognition of his work.

A. B. RENDLE

WE regret to announce the following deaths

Prof. Alexander Dougall Blackader, emeritus professor of therapeutics and pharmacology in McGill University, Montreal, past president of the Canadian Medical Association, on March 14, aged eighty-five years.

Prof. D. H. Marshall, emeritus professor of mathematics and physics in Queen's University, Kingston, Ontario, on March 14, aged eighty-four years.

Prof. Giuseppe Martinelli, assistant secretary of the Pontifical Academy of Science, Vatican City, and assistant in the Royal Central Office of Meteorology and Geophysics, Rome, aged fifty-four years.

Prof. Henry J. Priestley, professor of mathematics in the University of Queensland, Brisbane, on Feb. 26, aged forty-eight years.

## News and Views

### John Hunter

MR. WILFRED TROTTER gave the Hunterian Oration at the Royal College of Surgeons on Feb. 15, and his oration stands out among the long series as remarkable for the amount of interesting chronological analogies and psychological questioning which he has managed to compress into twelve pages. His best point is bringing out the fact that Hunter achieved his results, making modern, in fact, the practice of surgery, at a time when most of the discoveries of science on which we now rely had still to come. During his life, 1728–93, the biologist could look for little help from the sciences of the inorganic. The work of Cavendish, Priestley, Galvani, Volta, and Lavoisier was still to come. He would have had to wait ten years for Priestley's discovery of oxygen in 1775, and more than sixty for Wohler's synthesis of urea and the foundation of biochemistry in 1828. Joule's mechanical equivalent of heat came nearly eighty years later. Joseph Jackson Lister's compound microscope was sixty years ahead, and Lister's greater son did not make clear the nature of wound infections until just a century after Hunter. All this

enhances enormously the merit of Hunter. He stands out the more clearly as one of those successful practitioners of science, who by untiring work, scrupulous accuracy, and perfect devotion to truth have worked marvels.

### Purpose of Commemorations

MR. TROTTER's remarks, however, on the practice of commemorating the eminent dead, seem to us somewhat to obscure the main point of such commemorations by the curious psychological data which he suggests. There is a Freudian touch about it which, true as it may be genetically, is ontologically now invalid. Because primitive man did sacrifices to appease the 'manes' of the departed and was in actual fear of his ghost, it does not follow that there is any such dread of the reappearance of Hunter. His ghost would, we are sure, have been most cordially welcomed at Mr. Trotter's discourse on Feb. 15. Admiration as well as perfect love casteth out fear. Nor does the ancient practice of partaking of the bodily remains of the dead hero now prompt us to any really analogous act. We commemorate to

instruct ourselves, to inspire others to act in a way similar to that of the men we revere, perhaps, most of all, to impress the fact of the debt of the living to the past. The continuity of primitive savage instincts in the civilised is a plausible but misleading fallacy in psycho-analysis, and at the best a grave exaggeration. However, in Mr Trotter's address these allusions only add a quaint flavour of romance. We sympathise with him in his hope that the truly great may be recognised in their lifetime, but we would not have this at the cost of diminishing the respect and remembrance of them after their death. The growth of the latter practice is one of the best features of the age, and offers hope that we may be able to combine our vertiginous progress with the continuity of order.

### Third Pedler Lecture of the Chemical Society

PROF. L. RUZICKA, of Zurich, delivered the third Pedler Lecture to the Chemical Society on March 10, his subject being "The Life and Work of Otto Wallach." Prof. Wallach, whose outstanding contribution to organic chemistry was his pioneer work on the terpene series, was born in Königsberg on March 27, 1847, the son of a Prussian official. His early education was on classical lines, and in addition he had a lifelong interest in the contemplation of art. In 1867 he began his chemical studies in Göttingen under the direction of Wohler and his assistants, Fittig and Hubner. In the atmosphere of industry which was there cultivated, Wallach obtained his doctor's degree after five semesters of study, his dissertation dealing with position isomerism in the toluene series. After a short period in Berlin as assistant to Wichehauser, he accepted in 1870 an assistantship at Bonn, offered to him by Kekulé. The period at Bonn, which lasted for nineteen years, was interrupted for a short time when he went to Berlin as the sole chemist to a newly founded enterprise which later developed under the name "Aktiengesellschaft für Anilinfabrikation" (Agfa). In 1889 Wallach was called to Göttingen as successor to Victor Meyer, and retained the direction of the Chemical Institute until 1915. In 1908 he was elected an honorary member of the Chemical Society, and in 1909 received an honorary doctorate of the University of Manchester. The Nobel prize for chemistry was awarded to him in 1910. Wallach died on Feb. 26, 1931, having made such contribution to organic chemistry that any attempt to picture the science with Wallach's work removed would unmistakably disclose a severe gap.

### Wallach's Chemical Investigations

PROF. RUZICKA gave a brief sketch of the principal investigations conducted by Wallach in the domain of terpene chemistry. The work originated in a study of several samples of essential oils which had been kept untouched for fifteen years in a cupboard in Kekulé's private laboratory. It soon became evident that "a great many terpenes formerly designated differently and of supposedly varying constitution are undoubtedly identical." In the first stages several simple reagents were caused to act on the separate

fractions of natural terpene mixtures with the view of the separation of crystalline reaction products. In three years Wallach was able to list eight terpenes which obviously differed from one another, each being characterised without ambiguity: pinene, camphene, limonene, dipentene, sylvestrene, terpinolene, terpinene, and phellandrene. Later it appeared that dipentene is *dl*-limonene, and that pinene, terpinene, and phellandrene are mixtures of  $\alpha$ - and  $\beta$ -compounds; moreover, it is now known that sylvestrene does not occur in Nature. Wallach also investigated oxygenated terpene derivatives and the sesquiterpenes, particularly cadinene and caryophyllene. After characterisation of the individual terpenes, he considered the elucidation of their innumerable mutual relations to be more important than the determination of their constitution. The real harvest from the persistent work of Wallach was reaped in 1895, when, with a single stroke, the structure of an entire series of terpene compounds was elucidated. With the end, about this time, of the heroic period in terpene chemistry, Wallach ceased to play the part of pioneer. Of his later work, Prof. Ruzicka referred to that on bicyclic representatives of the terpene series, and that concerned with simple alicyclic compounds.

### Early History of Magnetism

At a meeting of the Newcomen Society held at the British Industries Fair, Birmingham, on March 2, Dr. J. B. Kramer read a paper on "The Early History of Magnetism", in which he discussed the various accounts of the first discovery of a magnet, and the development of the science of magnetism down to A.D. 1600. His remarks were divided into five sections, the first dealing with the discovery of magnetism up to and including the writings of Lucretius, about 95-52 B.C., the second with the interpretations and first applications of magnetism up to the thirteenth century, the third with the experimental researches of Peter Peregrinus of Maricourt, A.D. 1269, the fourth with the magnetic compass, between the thirteenth and sixteenth centuries, and the last with the discovery of terrestrial magnetism by Gilbert, and with Gilbert's book, "De Magnete."

### Discovery of Magnetic Properties

For the claim that is sometimes made that the magnet was first known to the Chinese, Dr. Kramer finds no support, but after examining the works of Aristotle and others, he comes to the conclusion that the magnet was discovered accidentally by one of the Grecian tribes who originally inhabited Thessaly and were called Magnetes. The discovery was made in one of the settlements in Asia Minor, in the Province of Lydia, about 600 B.C. That magnets attract through a distance, that they induce magnetism in iron, and that they repel as well as attract, are mentioned by Lucretius. Who made the great discovery that if allowed to move freely a magnet pointed north and south is not known, but Peter Peregrinus describes the dual polarity of magnets. The work of Gilbert was based on 199 'magnetical

experiments', and his greatest original contribution to science was his magnificent discovery and proof that the earth is a colossal natural magnet in itself. Dr Kramer's paper contains many extracts from the various writers on magnetism, and should prove of wide interest.

#### Goethe's Scientific Works

A SPECIAL issue of the Berlin journal, *Forschungen und Fortschritte*, dated March 1932, includes thirty-nine pages devoted to a series of articles by more than thirty authorities dealing chiefly with Goethe's influence as a man of science. The subjects covered include mathematics, the theory of colours and optics, chemistry, geology, meteorology, botany, zoology, and anatomy, together with an appreciation of the Goethe Museum at Frankfurt. In the restricted space at the disposal of each author, it has only been possible to deal very briefly with what are often abstruse and involved matters of history, but, nevertheless, these articles should prove a very useful guide to those who propose to take up the study of Goethe's scientific works. The modern critic of Goethe's central idea of the unity of plan has little to add to Schiller's acute observation of 1794, quoted by Prof O Abel—"Das ist keine Erfahrung, das ist eine Idee", and Goethe's response—"Das kann mir sehr lieb sein, dass ich Ideen habe, ohne es zu wissen, und sie sogar mit eigenen Augen sehe", is an admirable epitome of his own attitude towards the central idea.

#### Source of 'Nagana' in South Africa

DR E WARREN, director of the Natal Museum, has reported, according to a message in the *Times* of March 10, that experiments carried out by Mr Davidson, an independent naturalist, "completely destroy the theory at present accepted about the reservoir of infection from which the tsetse fly transmits the widespread cattle disease known as Nagana". It is generally accepted—and has, in fact, been repeatedly proved—that the blood of game animals harbours trypanosomes which, when conveyed to domestic animals by the tsetse fly, give rise to the serious and often fatal diseases which are grouped under the term 'nagana'. Mr Davidson now claims to have shown that the trypanosome responsible is derived from the latex of certain plants "on which the tsetse fly normally feeds". Further information on these observations (which appear to have satisfied Dr Warren, by whom they have been "carefully checked") will be awaited with much interest. It is well known that leptomonad-like flagellates are common in the latex of *Euphorbia* and other plants, being transmitted from one plant to another by certain plant-sucking bugs, but no evidence has as yet been published that these organisms can cause disease in vertebrates, and up to the present time no trypanosome has ever been discovered in a plant. The tsetse fly has occasionally been observed to plunge its proboscis into certain fruits, but in the past it has seemed very doubtful if these constitute a regular source of food supply.

#### Chester Roman Amphitheatre Appeal

DETERMINED efforts are to be made to save the Roman amphitheatre at Chester, which is threatened by the proposal to construct a by-pass road that, on the lines contemplated at present, would pass through the centre of the arena. The Council of the Chester and North Wales Archaeological Society has issued a statement in which it is pointed out that even if the road could be constructed without damage to the remains, which is doubtful, it would put excavation in the future out of the question, while it is inevitable that the northern area adjoining the road would be developed for building purposes, and also made inaccessible. The Office of Works, which has been approached in the matter, views with approval the scheme to save the amphitheatre, which is the most considerable in Great Britain. The Office of Works would itself undertake the cost of excavation and be responsible for the future maintenance of the monument if the site was placed in its keeping. The cost of diverting the by-pass road to avoid the amphitheatre is estimated at a sum of £8000. The Council of the Archaeological Society, therefore, appeals to the people of Chester, and of Great Britain, for a sum sufficient to enable this monument to be preserved. A stay of three months has been granted to afford an opportunity for the amount required to be raised.

#### Metallurgical Literature

THE annual general meeting of the Institute of Metals was held on March 9 and 10, and the incoming president, Sir Henry Fowler, delivered his address on the first day. Referring to the literature of metallurgy forty years ago, Sir Henry remarked that it was very meagre in Great Britain, especially as regards non-ferrous metals, and that possibly this lack was in part responsible for the formation of the Institute of Metals, for among its original objects was the publication of a journal containing original papers and abstracts. Abstracts appeared for the first time in the second volume of the *Journal* of the Institute, occupying 41 pages. In the last issue of the *Journal* in which they were incorporated, they occupied (with index) 436 pages. Now that the *Journal* is being published monthly, it is hoped that abstracts will be available within six weeks of the original publication of important papers. Sir Henry stated that more than a thousand periodicals, in about twenty languages, are searched systematically by a band of more than thirty qualified abstractors, who provided in the past twelve months more than four thousand abstracts. The magnitude of this undertaking is probably unique as the work of a single institution.

#### Practical Applications of Fundamental Research

SIR HENRY FOWLER went on to speak of the importance of fundamental research and of the 'marrying-up' of research with its practical applications. There is nowadays unquestionably much better understanding between the research worker in metallurgy and the practical engineer, due to the

increased facilities for metallurgical education and to the growing importance of metallurgy. Difficulties are still met, however, when the research worker neglects to express himself simply and intelligibly, or the practical man may be unduly conservative as regards new ideas. Sir Henry quoted one example from his own experience in which prejudice was likely to obstruct the application of research in practice. In 1922 he heard incidentally that a small percentage of copper increased the corrosion-resisting properties of steel. Owing to the story, apparently, that if a puddler wished to get a fellow-worker into trouble, he threw a penny into the puddling furnace, it was difficult to get the material made. Finally, Sir Robert Hadfield accepted the order for a small cast of 'copper-bearing steel'. The metal was required for the smoke-box and ash-pan plates of locomotives, and it took a further six or seven years to show that better results were obtained than with ordinary steel, thus emphasising another point, that the practical test of a discovery should be started as quickly as possible without awaiting its full development. The research associations are invaluable in bringing together those directly engaged in industry and those conducting research.

#### Land Utilisation Survey

THE Land Utilisation Survey of Britain organised by the London School of Economics and the Geographical Association, under the direction of Dr L. Dudley Stamp, reports considerable progress during its first year. A general report on the work is given in the *Bulletin of the Survey* for February. After fifteen months' work, four counties in England and one in Scotland are completely finished and another eight counties are on the verge of completion. Of the 22,000 quarter-sheets of the 6-inch map of Great Britain, 3670 have been finished. This is good progress, when it is borne in mind that the work had to be organised from the start in every county and is entirely on a voluntary basis. The completed sheets are being reduced to a 1-inch scale, and will then be printed in seven colours and issued by the Ordnance Survey. The numbering of these sheets will be on the basis of the popular edition of the 1-inch map. Sheet 114 (Windsor) is to be produced as an experimental sheet. While work is proceeding rapidly, in parts of the country, particularly in some of the counties of northern England, there are several areas in which little has yet been done. These blank areas include Gloucestershire, Essex, Huntingdon, several Welsh counties, the North Riding of Yorkshire, much of Northumberland, south-west Scotland, and large areas in the central and western Highlands. For these and other regions workers are still required.

#### Natural History in Church Records

It is strange from what odd quarters knowledge about the history of animal life may be gathered. This was apparently also the opinion of the vicar of Ridge, who refused permission to examine his parish books, on the ground that he found it difficult to conceive that payments for 'vermin' by parish

authorities could be of interest to anyone. Fortunately no other refusal was met by Charles Oldham, and the results of his searches amongst churchwardens' records in Hertfordshire are some odd contributions to the history of vermin (*Trans Hertfords Nat Hist Soc*, vol. 19, pt. 2, 1931). Sparrows, which had increased enormously in numbers because of the intensive cultivation of cereals, had a price upon their heads, and a record (Aldbury) of 1720 reads, "Pd for 6 Doz of Sparrows heads

1s", and yet, at the same period, others were deliberately encouraging sparrows to multiply by setting up for their use curious receptacles, 'sparrow-pots', from which the young sparrows were taken for food. The most telling of all the records are those relating to the prices paid for the destruction of polecats. In 1721, at Chipping Barnet, 4d was paid for two, in 1723 "for 4 Polecatt 4s" was paid at East Barnet, these records, giving the extreme range of prices, indicate a common and almost worthless creature, and contrast with the demand in Scotland, where at one stage the price of a furrier's dozen of polecats reached 45s. Long before that time, in the mid-nineteenth century, when fur value of the polecat had made its pelt desirable, the polecats of Hertfordshire had been exterminated as 'vermin'.

#### Irish Forests

THE opinion was widely held amongst Irish and English historians of the eighteenth and nineteenth centuries that Ireland was densely wooded down to the last five hundred years, and that the disappearance of the native forests was chiefly due to their exploitation by English adventurers, and the effects of the wars and disturbances during Elizabethan and Cromwellian times. According to A. C. Forbes in his paper on "Some Legendary and Historical References to Irish Forests and their Significance", read before the Royal Irish Academy on Feb. 22, a review of the various authors who were responsible for this conclusion has shown that none can be considered sufficiently acquainted with Ireland to have been an authority on the subject. State papers and other documents indicate that the arrival of the Normans in the twelfth century found Ireland much as it is to-day. A point of considerable interest is the exact position of forest land under the forest laws of the Normans. This forest land was the waste or unenclosed portion of the country, and had no direct connexion with woods or timber trees. Two Irish deafforestation charters of the thirteenth century are in existence, but no record can be found of any proceeding for creating a forest, and Mr Forbes advanced the theory that the wastes of both Ireland and England were normally afforested or subject to forest laws at a remote period, and that these laws were gradually removed by deafforestation, for which money payments were frequently made to the Crown. Manwood's "Lawes of the Forest" is a doubtful guide on this subject. A further point of interest is the existence of *Pinus sylvestris* in the Irish flora during the historic period. While the pine was a dominant species when the older

bogs were being laid down, its existence as an indigenous tree during the last thousand years is extremely doubtful

#### International Federation of Eugenic Organizations

WE have received a copy of the report of the ninth Conference of the International Federation of Eugenic Organizations, edited by the honorary administrative secretary, Mrs C B S Hodson, and published at 406 Fulham Road, London. The Conference met on Sept 11-15, 1930, at Farnham, Dorset, and Larmer Tree Grounds, Tolland Royal, Wilts. Associated public meetings were held at the Tithe Barn, Hinton St Mary, Dorset, at the invitation of Capt Pitt-Rivers. The first conference, under the chairmanship of Sir Arthur Keith, considered the standardisation of human measurements, with opening papers by Miss M L Tildesley on the physical and Miss B Schieffelin on the mental side. A conference on race crossing, with Dr Alfred Ploetz in the chair, received contributions from Dr Mjoen, Prof C G Seligman, Dr van Herwerden, Prof Ruggles Gates, Dr C B Davenport, and Prof Eugen Fischer. At another session international programmes for research in racial psychiatry were presented by Prof Rudin, and in racial psychology by Prof Seligman. An afternoon was devoted to heredity in man, with Prof Gates in the chair, and contributions by Dr P J Waardenburg, Dr C J Bond, Dr G P Frets, and Dr Heuyer. The report includes a summary of the discussion on each paper. The last part is devoted to general reports, including a brief statement from twelve countries regarding work on the eugenic or dysgenic effects of the War, and statements concerning recent eugenic work in Czechoslovakia, Finland, South Africa, Holland, Germany, and Austria. Dr H H Laughlin contributes a survey of eugenical work in the United States, Dr Mjoen one for Norway, and Dr Schrieber for France. This pamphlet of a hundred pages is a useful summary of work having anthropological and medical as well as eugenical aspects.

#### Wood Decay in Motor-Cars in the Tropics

THE practical importance of this question is indicated in a brief note in the *Philippine Journal of Science* (vol 46, No 2) by C J Humphrey, mycologist to the Bureau of Science, Manila. He states that the depreciation of imported automobiles in the tropics from this cause reaches "a staggering figure in proportion to the investment". Most of the cars in the Philippines are American, a few come from Europe, in either case the woods used in their construction are almost exclusively temperate zone species, selected for other properties than their durability. The decay sets in as the result of moisture in the wood, but, under the conditions in the tropics in the rainy season, water almost inevitably penetrates and, in the humid atmosphere, does not easily dry out again. The author states that "six months under test conditions very highly favourable for decay will destroy for all practical use nearly all the temperate zone woods now used in American or European-made cars". Up to the present three species of the higher fungi have been observed fruiting on the

rotting wood taken from cars, many more species probably contribute, but most of them are Hymenomycetes. The remedies for the trouble seem clear either the use of the heartwood of durable species of timber, presumably tropical species, by the manufacturer, or else the non-durable timbers must be adequately treated with a preservative.

#### Light upon Eggs

ANALYSIS shows that an inverse relation exists between the amount of daylight and the price of hens' eggs in successive months of the year. That in turn is correlated with the amount of food a hen may eat per day, so that the more light, the more food, and, other things being equal, the more eggs. Artificial lighting has been used on a large scale in the United States to shorten the long nights and induce hens to lay more, but it cannot be said to be a common practice in Britain. The results obtained by J W Rhys and Raymond T Parkhurst at the National Institute of Poultry Husbandry suggest, however, that its use might well be extended (*Bull* No 6). During the winter months the 120 pullets under lights laid 950 more eggs than an equal number without lights. For the 48 weeks of the test the lighted pen yielded 1086 eggs more than the unlighted pen. The lighted pullets laid an average of 173.5 eggs and the unlighted 161.0 eggs. Financially, the 'morning and evening lights' pen was most successful, the margin of profit over food and lighting costs being 11.58 pence a dozen eggs. Hens apparently give the best results under a 14-hour day.

#### The First 'Sky-scraper'

A POINT of considerable interest in the history of architecture has just been settled by a joint committee of the American Institute of Architects and the Illinois Society of Architects, which, having watched the demolition of the Home Insurance Building in Chicago, has declared it to be "the first tall structure of metal construction". The essential feature of a 'sky-scraper' is the metal skeleton, defined as "a type of construction in which a metal frame or cage, composed of girders, beams, and columns, supports all internal and external loads and carries all stresses to the foundations". Claims had been set up that the Tacoma Building of 1888 was the first tall metal skeleton building, but the committee states that in the Home Insurance Building there was "a complete skeleton framework, floor loads were carried by both interior and exterior columns, wall loads were transferred to columns, and columns were supported on independent footings". The Home Insurance Building was designed by William Le Baron Jenney and was erected in 1885. It has now been removed to make room for the gigantic Field Building in which 25,000 tons of steel will be used, but it will henceforth have its place in history as the first 'sky-scraper'.

#### Economic Uses of Beryllium

AMONG the rarer metals which are light in weight and therefore suggest themselves for employment in the aircraft and automobile industries, beryllium

stands out prominently. It is lighter than aluminium and has a much higher melting point than either aluminium or magnesium. In order to provide authoritative information about beryllium and the distribution of deposits of beryl—the only source of which adequate supplies are available—a useful little monograph has been prepared by the Mineral Resources Department of the Imperial Institute ("The Mineral Industry of the British Empire and Foreign Countries—Beryllium (Glucinum) and Beryl", 1931, pp. 26, price 6d). At present the metal is being produced commercially only in Germany and the United States. However, it is clear from the details provided that the British Empire is in a strong position to exploit its resources of beryl if adequate financial help can be found to follow up the preliminary work already accomplished in the field and laboratory. As is usual in this well-known series of monographs on economic minerals, there is a very full bibliography of the leading literature on the subjects dealt with.

#### National Institute of Industrial Psychology

THE eleventh annual report and the accounts for the year 1931 of the National Institute of Industrial Psychology have recently been published. The development of the Institute's work, in spite of the present financial crisis, continues satisfactorily. There is reported an increase of more than twenty-six per cent in the number of industrial and commercial firms for which the Institute has carried out investigations during the year, and an increase of nearly seventeen per cent in the number of cases examined for vocational guidance. The investigations are concerned with very varied activities, including work in gold mines, gasworks, a fish paste factory, and schools, and the problems investigated include equipment and lay-out of factories, as well as bonus schemes and staff selection. The very valuable work on vocational guidance continues, and while the Institute has acquired knowledge which enables it to advise young people on the choice of a career, yet it is recognised that much remains to be done—research work which will require several years for fruition is in progress. An allied problem, namely, occupational analysis, is also being continued, and studies being made of the abilities required for the various types of women's secretarial work and nursing. Other researches described include the nature and measurement of the mental abilities involved in factory assembly operations, motor drivers' tests, colour discrimination, and a very important investigation into the part played by rhythm in typewriting.

#### Health of the Army

THE health of the Army, at home and abroad, during 1930 is dealt with in the War Office Report recently issued (H.M. Stationery Office 2s 6d net). The ratio per 1000 of the strength of men admitted to hospital was 428.4, which is the lowest since the War, with the exception of 1928. Malaria caused 7365 admissions, venereal diseases, 6146, and inflammation of the tonsils, 5519. The principal causes

of invaliding from the Army were tuberculosis, 200 cases, and middle ear disease, 182 cases. Enteric fevers accounted for only 253 cases, of which 207 were in India. A single case of undulant fever is reported, an *abortus* infection at York. There were 534 cases of pneumonia, with a case mortality of 10.6 per cent. It is of interest that the pneumonia figures of forty years ago, selected at random, give a mortality figure of 12 per cent. Considering the less efficient nursing then available, this suggests that effective treatment of pneumonia has not materially advanced. Some details are given of researches carried out by officers of the Royal Army Medical Corps.

#### International Oceanography

PROF. R. DE BUEN, with the co-operation of leading international oceanographers, has compiled a valuable chronological list of voyages, long and short, made by vessels of all countries that have resulted in addition to oceanographical knowledge ("Lista cronológica de las campañas y navegaciones a las que se deben observaciones científicas de carácter oceanográfico". Memorias del Consejo Oceanográfico Ibero-Americano, No. 5, Madrid, 1930). The entries are arranged separately for each country, and indications are in most cases given of objects or results of the voyages, names of the leaders, and in some cases of scientific personnel. The compiler is open to receive corrections or additions to the list, which indeed appears to be very complete already. The earlier entries, which begin at the end of the fifteenth century, are for voyages primarily of a geographical nature. It is interesting to note that the British records, although not given in great detail, occupy nearly one-half the whole.

#### Agricultural History

THE Agricultural History Society of America wishes to secure as full bibliographical information as possible relating to books or essays on agricultural history for inclusion in its quarterly journal. Writers in the British Isles of essays on farming history and the history of rural life in all its phases, are therefore requested to forward details of their publications from time to time to the Associate Editor for Great Britain, Mr G. E. Fussell, at 47 Maple Street, London, W.1. Information regarding sections of scientific works which contain historical data, works of general history, or the history of specific trades or districts which contain sections dealing with agricultural history, might also be included. The quarterly journal of the Society, *Agricultural History*, is obtainable on payment of an annual subscription of three dollars, which should be forwarded to the Treasurer, Agricultural History Society, Room 304, 1358 B Street S.W., Washington, D.C., U.S.A.

#### The Remsen Memorial Collection

FORMER students in chemistry at Johns Hopkins University have organised the chemistry alumni of the University, with Dr. Harry N. Holmes, of Oberlin College, as president, and Dr. Lyman C. Newell, of Boston University, as secretary. Two meetings are held each year, ordinarily at the time of the meetings



of the American Chemical Society. At the last meeting it was decided to establish a Remsen Memorial Collection, and an appeal has been issued for early portraits of Dr Remsen, autographed letters on scientific subjects, and inscribed copies of the first, or an early, edition of his books, particularly books in a foreign language. Those who have memorabilia of this kind are requested to write to Dr Lyman C Newell, 688 Boylston Street, Boston, Mass.

#### Science in Poland

THE recent issue of vol 14 of "*Nauka Polska*" (Science and Letters in Poland), published by the Institute for the Promotion of Science and Letters in Poland (J Mianowski Funds, Warsaw, Staszic Palace 1931), is in line with the former volumes of this publication. It contains several original articles on the organisation and progress of science in Poland, as well as in Germany, Hungary, Czechoslovakia, Yugoslavia, Spain, and the United States. One article gives a review of the professorial members of Polish State universities. News of scientific activities and congresses both in Europe and America and reviews of new books are also included.

#### Science Abstracts

ALTHOUGH the volumes of *Science Abstracts* for 1931 are slightly less than those for the previous year, they include a larger number of abstracts: in physics 4365, of average length 0.254 page, and in electrical engineering 2697, of average length 0.262 page, there having been a marked decrease in the latter figure from last year. Both author and subject indexes are ample, and the two volumes continue to be indispensable for reference.

#### Announcements

At the annual general meeting of the Society of Public Analysts, held on March 4, the following were elected as officers for the year 1932: *President*, F W F Arnaud, *Hon. Treasurer*, E B Hughes, *Hon. Secretary*, G Roche Lynch.

At the annual general meeting of the Ray Society, held on March 10, the following officers were elected: *President*, Sir Sidney F Harmer, *Treasurer*, Sir David Prain, *Secretary*, Dr W T Calman. Sir J Arthur Thomson, Prof F E Weiss, and Mr E T Browne were elected new members of Council. In the report of the Council it was announced that the second volume of "*British Freshwater Copepoda*" is in the press and will be issued to the subscribers for 1932. It was also announced that Dr R W T Gunther has presented to the Society a portrait of his late uncle, Prof W C McIntosh. By permission of the President and Council of the Linnean Society, the portrait has been hung in the rooms of that Society.

IN connexion with the Thomas Gray Memorial Trust, the objects of which are the advancement of the science of navigation and the scientific and educational interests of the British mercantile marine, the Royal Society of Arts, which founded the trust

as a memorial to Thomas Gray, formerly assistant secretary to the Board of Trade (Marine Department), is again offering two prizes, each of the value of £100. One prize will be awarded for a valuable improvement in navigation proposed or invented in 1931 or 1932, and the other for an essay in connexion with navigation. Further particulars can be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, London, W C 2.

A CATALOGUE (No 386) of nearly 3000 works relating to practically all branches of science, and a section on publications of the learned societies, has just been issued by Messrs W Heffer and Sons, Ltd. Petty Cury, Cambridge. It should be of interest to many readers.

AN item of particular interest to be included in the sale by auction by Messrs Sotheby and Co., 34 New Bond Street, W 1, on March 21 and the following day is Michael Faraday's electrical plate machine, made to his order by E G Wood of Cheapside, 1830, and exhibited at the Faraday Centenary Exhibition in September last. The sale will also comprise some letters of Charles Darwin and F T Buckland, and a collection illustrating savage art, from Africa, America, Oceania, and New Zealand.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A sub-librarian of the Literary and Philosophical Society, Newcastle-upon-Tyne—The Librarian, Literary and Philosophical Society, Newcastle-upon-Tyne (March 28). A woman lecturer in mathematics at the Bingley Training College—The Education Officer, County Hall, Wakefield (March 30). A principal of the Sunderland Municipal Technical College—The Chief Education Officer, 15 John Street, Sunderland (April 9). A pathologist, a radiologist, and a pharmacist at the Southend-on-Sea New General Hospital—The Secretary, New General Hospital, Southend-on-Sea (April 10). A woman lecturer in biology at the Edge Hill Training College, Liverpool—The Principal, Edge Hill Training College, Liverpool (April 29). A demonstrator in physiology and a part-time demonstrator in geology at the Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N W 1 (April 30). An assistant in the department of technology, City and Guilds of London Institute, for technical examination work, preferably with industrial knowledge, who has taught engineering or chemical subjects—The Superintendent, Department of Technology, City and Guilds of London Institute, 31 Brechin Place, S W 7. A director under the International Tin Research and Development Fund, to organise and direct international research and development, with the object of expanding the existing markets for tin, and of finding new uses for the metal—Sir John Campbell, 2 Richmond Terrace, London, S W 1. A professor of education and head of the men's training department of the University College of South Wales and Monmouthshire—The Registrar, University College of South Wales and Monmouthshire, Cardiff.

## Letters to the Editor

*[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]*

### The Expanding Universe

SIR ARTHUR EDDINGTON's recent work is of extraordinary interest, though there is some difficulty in getting hold of the right end of the stick. His recent Friday evening discourse at the Royal Institution appears elsewhere in this issue, however, and he also gave a rather fuller account of the work in his presidential address to the Physical Society last November.

It appears that in Einstein's theory of gravitation there are two terms in the expression for the gravitational action of one piece of matter on another. One term is the usual attraction, varying inversely with the square of the distance, while the other is a much smaller term, which can usually be neglected, representing an opposition force, or what can be spoken of as a repulsion, varying as the direct first power of the distance. This last only becomes important at enormous distances, but it is clear that at some distance or other it must first equilibrate the attraction, and then overpower it. It is obvious that the equilibrium thus obtainable between attraction and repulsion must be of the unstable kind, and it is supposed that if at one time the universe was in that critical condition of equilibrium as regards the matter on the outskirts of the whole system, the repulsion has now got the upper hand, so that any very distant matter is now receding, and receding with increasing speed as the distance increases. The result would seem to be that the matter outside the equilibrium boundary would gradually go away to infinity, while the matter inside that boundary would gradually contract.

I remember discussing with the late G. F. Fitzgerald how it came about that the forces between particles of matter were all of one sign, so that all matter attracted every other kind, and wondering whether there was any kind of matter that would be repelled, on the analogy of electric charges. Fitzgerald's view was that if there was any of the opposite kind of matter, it would have been repelled long ago, and could only be found at infinity. The Einstein theory, however, does not postulate another kind of matter, but another kind of force acting on all matter, so that it is all subject to both attraction and repulsion, though, in a reasonable neighbourhood, attraction is dominant.

Eddington, however, has further examined the repulsive term, or what he calls the cosmic constant, and finds that it, like the attractive one, can be related to a hypothetical curvature of space, so that what he speaks of as 'the expanding universe' does not signify merely an expansion of the universe of matter, but an expansion of the whole continuum in which the matter exists. This is a much more difficult idea than an effect on matter alone. It may be asked why the continuum should behave as a unit and all act together. The curvature of space is presumably due to the matter in it, the radius of curvature depending on the amount of matter. By certain equations, hitherto associated with atoms and electrons, Eddington considers that he has been able to calculate the radius of curvature of space, at least for the equilibrium condition, also the rate at which it should increase, and likewise the original amount of matter contained in space. He finds this amount equivalent to  $10^{79}$  atoms of hydrogen. If the amount of matter is gradually decreasing, owing

to its conversion into radiation, then it may be reasonable to suppose that the radius of curvature is increasing, unless indeed the radiation generated by the conversion can be considered gravitationally equivalent to the matter whence it was derived. For the radiation can never get out of the curved space, and so the content of that space may be considered constant, whichever form it happens to take.

There seem to be some discrepancies here, so that I feel sure I have not stated the position accurately, but in a subject of this novelty an old-fashioned physicist may be allowed to ask questions, and one way of asking a question is to make a statement and ask for a correction. One can but admire the heroic and apparently successful attempt of Sir Arthur Eddington to calculate a value not only for the things already mentioned, including a recessional velocity in remarkable agreement with spectroscopic shift, but also for the relative mass of a proton and an electron. I only hope that his theory will stand scrutiny.

OLIVER LODGE

Normanton House,  
Lake, Salisbury

### Leadership and the Royal Society

MANY will sympathise with Dr. Norman Campbell in his desire that the Royal Society should ever exercise that leadership which is its right, all will regret that he should have supported his views by such misleading statements as are contained in his letter in NATURE of March 5. He states that "the only evidence"—of scientific merit—"demanded is a complete list of the candidate's scientific publications." No such list is ever asked for by the Society, no evidence is demanded from the candidate himself.

The Society is bound by its statutes, which provide that "Every Candidate shall be proposed and recommended by a certificate in writing signed by six or more Fellows. The certificate shall specify the name, rank, profession, qualifications, and usual place of residence of the Candidate." The statutes also assign to one of the signatories, acting as proposer, the duty of "informing the Candidate of the Obligation to be subscribed to before he can be admitted as a Fellow", and require that the certificate shall be suspended in the rooms of the Society.

In some cases, no doubt, the proposer thinks it desirable to add to the certificate a list of publications, there is no demand for this, and I agree with Dr. Campbell in thinking that little attention is paid to it. I have taken part in the selection of fellows on many occasions, and do not remember one on which the list was referred to.

Dr. Campbell continues with a list of qualifications about which he says no inquiry is made. Long experience enables me to deny this, and to state that information of the kind indicated is always available and is considered by the council at the time of selection. It is obtained not from the candidate himself—he is asked no questions—but from his supporters and those conversant with his work.

Another statement made by Dr. Campbell is the following: "Election to fellowship confers rights and privileges, it imposes no duties." Let me again quote the statutes: "Every person elected a Fellow of the Society shall, before his admission, subscribe the Obligation in the following words:

"We who have hereunto subscribed, do hereby promise each for himself, that we will endeavour to promote the good of the Royal Society of London, for Improving Natural Knowledge, and to pursue the ends for which the same was founded."

As to those ends, they are to be found in the charter of 1662, here are the words of our founder, Charles II

"... we look with favour upon all forms of learning, but with particular grace we encourage philosophical studies, especially those which by actual experiments attempt to shape out a new philosophy or to perfect the old"

So the King founded the Royal Society, enjoining on the fellows and their successors that their "studies are to be applied to further promoting by the authority of experiments the sciences of natural things and of useful arts"

These are the ends for which the Society was founded, and its long record shows how brilliantly it has set itself, and still continues, to achieve them, working as a band of fellows

It happens that on the morning of Friday, March 4, before I had seen Dr Campbell's letter in NATURE, I wrote a brief note to one of those whose names appeared in that morning's *Times*, congratulating him that I could now claim his help, not as that of a kind friend, but as a brother fellow, and that, I believe, represents the feelings of the fellows towards their colleagues

Of course, fellows do recognise it as their duty and privilege to serve their humbler colleagues. *Noblesse oblige* is their motto, and as a senior member of the Society, I claim that it is still animated by the spirit of its founders, and does care far more for the welfare of science than for the dignity of its fellows

R T GLAZEBROOK

Ballards Oak,  
Limpfield, Surrey

### Complex X-Ray Characteristic Spectra

It is well known that for the excitation of the characteristic X-ray spectra of elements, an electron has first to be removed from some internal level, when this is done, an electron from an outer level jumps to this vacant place, and characteristic radiation is emitted. The spectrum is called *K, L, M* according to the level of the atom from which the electron was first removed

This explanation suffices for the origin of the diagram lines, which show the same structure as lines due to alkalis, but there are, besides, other lines, the origin of which is still a matter of debate. Some of these have been traced to forbidden transitions,<sup>1</sup> but in addition, there are the so-called spark lines, which appear as faint satellites to the diagram lines. Hypotheses<sup>2</sup> have been advanced which ascribe these to double ionisation and single transition

In this note we wish to direct attention to the existence of a third class of characteristic lines, which are due to *double ionisation and double transition*. Suppose in one single act of bombardment of the anticathode by electrons, two electrons are removed simultaneously from an internal level, say one from  $L_1$ , the other from  $L_2$ , and these places are filled up by simultaneous passage of electrons from higher levels, say one from  $M_1$ , the other from  $M_3$ . It can be shown from quantum principles and from analogy with optical spectra that one of the transitions will be allowed, the other forbidden, so that in the above example the transition may be written as  $(L_1 L_2 \leftarrow M_1 M_3)$ , it is a composite transition and is the sum of the two transitions (1)  $L_2 \leftarrow M_3$ , which is allowed, and (2)  $L_1 \leftarrow M_1$ , which is forbidden. Lines due to such transitions are quite common in optical spectra, for example, in the case of Ba  $6s^2 1S_0 - 5d 6p 1P_1$ ,  $\lambda 3501$  cited by Russell and Saunders<sup>3</sup> in their classical paper on the spectra of alkaline earths

There is no reason why double transitions should not occur in the X-ray region. But *their frequency will be approximately double the frequency of the usual L-lines*, and since the electron configuration in this case is  $2s 2p^5 \leftarrow 3s 3d^9$ , the lines will form a multiplet  $(^1P, ^3P) \leftarrow (^1D, ^3D)$ , provided Russell-Saunders coupling continues to hold in such cases. *The fact that their frequency will be double the usual L-spectrum frequency marks them out as a distinct class*

Attempts have been made in this laboratory to obtain such lines from a tungsten anticathode, and two lines have been obtained with the wave-lengths  $\lambda = 723$  and  $682$  X U. They are diffuse lines impressed on a continuous background, and may be found to be attended with satellites when higher resolution is used. These wave-lengths are approximately half the wave-length of tungsten L-lines. After searching the literature to determine whether such lines have been noticed by any previous worker, we find that Rogers<sup>4</sup> noted in 1923 the following lines from tungsten  $\lambda = 1450, 1373, 1321, 1248, 7, 1230, 1114, 1086$  X U. These have not been traced to the tungsten levels, or identified as satellites or non-diagram lines, and cannot be ascribed to any other element. But it will be seen that the wave-lengths of the first two of Rogers' lines are very nearly double the wave-length of the lines obtained by us. Hence it may be safely concluded that the lines obtained by Rogers are the same double transition lines obtained in the second order

The full multiplet will be dispersed over a large wave-length range, and, with our present apparatus, such long exposures (amounting to a hundred hours) are needed that considerable time must elapse before the whole set of lines can be photographed. But the fact that double L-frequency lines have been obtained at all indicates that the ideas presented here are essentially sound

We think that we have established the possibility of getting double transition lines constituting complex spectra in the X-ray region. To get double transition or multiple transition lines due to all elements will be a vast programme, but when this is done, it will probably afford us very useful material for working out coupling problems inside the atom. The idea probably explains the numerous critical levels obtained by Richardson and his students for the most part, these levels have no apparent connexion<sup>5</sup> with the recognised X-ray levels which give rise to the diagram lines. This fact is at present inexplicable, but supposing the quantum theory can be adopted to explain the fact, then combining this with the ideas presented here, we find that we get an unforced explanation of the numerous levels obtained by Richardson, and need not give up the Bohr-Stoner levels (cf Richardson<sup>6</sup>). The *J*-phenomenon also does not appear to be so inconceivable, as according to our views we may have characteristic lines approximately double the frequency of ordinary K-lines \*

M N SAHA  
SALIGRAM BHARGAVA  
J B MUKERJI

Department of Physics,  
University of Allahabad, Feb 5

<sup>1</sup> S Idei, *Sci. Reports Tôhoku Imp. Univ.*, 19, 560

<sup>2</sup> B B Ray, *Phil. Mag.*, 8, 772, 1929. Langer, *Phys. Rev.*, 37, 457, 1931

<sup>3</sup> Russell and Saunders, *Astro. J.*, 61, 38

<sup>4</sup> Lindh, "Handbuch d. Experimentalphysik", xxiv/2, p 172

<sup>5</sup> Chalklin, *Sci. Prog.*, Jan 1932, p 437

<sup>6</sup> Richardson, *Proc. Roy. Soc. A*, 128, 63, 1930

\* The following cablegram dated Feb 29 has been received from Prof Saha

Double transition K-line approximately double frequency K-alpha three obtained copper —SAHA.

### Rotation of Chain Molecules in Solid Paraffins

It is found that the thermal expansion of the crystal lattice of *n*-paraffins is not equal in all directions.<sup>1</sup> The increase in length of the *a* axis measured in the range of liquid air temperature to room temperature is about 7 per cent, of the *b* axis about 2 per cent, whereas the *c* axis remains practically unaltered. This axis is parallel to the chain axes of the molecules.

Recent X-ray measurements on a series of solid paraffins between room temperature and the melting points show that the *a* axes continue to increase at a higher rate than the *b* axes. The result is a change in the lattice dimensions which will be discussed presently. Fig 1 (i) illustrates the packing of the molecules characteristic of all the members of the series. This arrangement is observed when the substances are at room temperature. Fig 1 (ii) is the corresponding pattern near the melting points.

The rectangles represent the boundaries of the cross-section through the unit cell containing the *a* and *b* axes. The long axis of the chain molecule is perpendicular to the plane of the paper. The projections of the chains, which consist of a zigzag arrangement

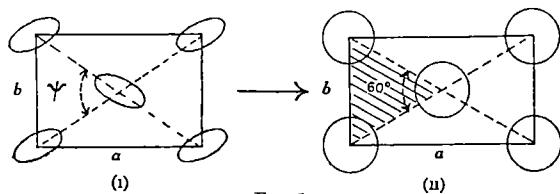


FIG 1

of  $\text{CH}_2$ -groups, are shown as ellipses in Fig 1 (i). There are two types of orientations present of these ellipses when the crystals are at room temperature. The angle  $\psi$  is between  $67^\circ 10'$  and  $67^\circ 40'$  at  $18^\circ\text{--}20^\circ\text{C}$ .

The angle  $\psi$  depends upon the temperature. It decreases with rising temperature, the expansion of *a* being larger than that of *b*, until it reaches  $60^\circ$  near the melting point. This is found to happen with  $\text{C}_{21}$ ,  $\text{C}_{23}$ ,  $\text{C}_{24}$ ,  $\text{C}_{25}$ ,  $\text{C}_{26}$ ,  $\text{C}_{27}$ ,  $\text{C}_{29}$ ,  $\text{C}_{30}$ ,  $\text{C}_{31}$ ,  $\text{C}_{34}$ ,  $\text{H}_{44}$  and can, therefore, be regarded as the general behaviour of the whole series within that range. If  $\psi = 60^\circ$ , the triangle shown by cross-hatchings is equilateral and the arrangement in (ii) has apparently higher symmetry than the original arrangement (i).

The transition from (i) to (ii) is continuous, that is, there is a gradual change of the two axes *a* and *b* as the temperature increases with  $\text{C}_{21}\text{H}_{44}$  and  $\text{C}_{23}\text{H}_{48}$ . From  $\text{C}_{24}\text{H}_{50}$  onwards all the samples investigated show a sudden transition at about  $5^\circ$  to  $10^\circ\text{C}$  below the melting point of the individual substance. The arrangement after this transition has taken place is still of the same type as (i) and approaches (ii) gradually as the temperature gets near the melting point. These transitions are incidentally those for which Garner and his collaborators have measured the heat of transition.<sup>2</sup>

The change from a less symmetrical arrangement at low temperature to another of higher symmetry at high temperature is not difficult to visualise. The moment of inertia of the chain molecule relative to its axis is comparatively small, and oscillations of large amplitude or complete rotations are to be expected at higher temperatures. Such oscillations obviously tend to produce fields of force round the chain axes which, when averaged, show radial symmetry and produce the simple close packed structure found in the present experiments.

The observations show that too high a symmetry

may be observed in a crystal if the temperature at which the measurements are made is above a certain limit. A similar case for a crystal of amylammonium chloride has recently been discussed by Pauling.<sup>3</sup>

ALEX MULLER

Davy Faraday Laboratory,  
Royal Institution,  
London, W 1,  
Feb 24

<sup>1</sup> *Proc. Roy. Soc., A*, **127**, 417, 1931

<sup>2</sup> *J. Chem. Soc.*, p 1533, 1931

<sup>3</sup> *Annual Survey of American Chem.*, **15**, 118-125

### *Ovis astore*, a Three-Coated Sheep

IN Prof Barker's description of the sheep from Astore (Gilgit),<sup>1</sup> several points which bear upon his subsequent discussion of the development of the fleece of domesticated sheep are not clear. For example, it would be of great interest to know (1) whether the individual animal described is typical of many in that locality, that is, of a local variety or 'breed' or is a crossbred, and (2) the conditions of husbandry under which the animal had been maintained while the coat was grown, since changes of husbandry, including nutrition, can give rise to marked changes in thickness of the fibres throughout their lengths.

The difficulties encountered in endeavours to relate the coat constitutions of domesticated sheep with a two-coated primitive type are mentioned by Prof Barker, but when questions other than those of fibre structure are introduced, the situation becomes more complicated, since a classification of the constituent fibres into two groups is no longer possible. Crew,<sup>2</sup> while insisting upon the two main types of hair and wool, distinguished three groups of *hairs* when classed according to length and colour in the summer coat of *O. ammon poli*. The coat of domesticated sheep exhibits two types of fibre—kemp and wool—and Fraser Roberts has shown that the distinction between these can best be made according to period and duration of growth, the 'heterotypes' of Duerden are fibres which exhibit kemp-like structures for a part of the length. Again, in the normal coat of the Scotch Blackface breed, the so-called 'double-coat' is really a triple coat, since the obvious groups of fibres are (1) kemp, (2) coarse, long fibres, and (3) fine, under-coat fibres.

Fraser Roberts, in a series of papers on "Colour Inheritance in Sheep",<sup>3</sup> discusses the various regional differences in coat pigmentation and describes the types of pigmentation found in individual fibres in the coats of primitive forms, if fibre pigmentation is included, the possible classification of coat fibres is greatly extended. In the Suffolk breed occur kemps, coarse wool fibres, and fine wool fibres, each of which may be, at least, wholly pigmented, non-pigmented, banded, or parti-coloured, and even in the adult fleeces of this breed there appear to be different thresholds of pigment inclusions for the various types of fibre, it having been noted, for example, that the kemps are more likely to be pigmented than are the neighbouring wool fibres growing during the same period.<sup>4</sup> Further, in the Merino breed, with no coat colour pattern, individuals which show 'banded' fleeces are not uncommon, and Boyd<sup>5</sup> recognised four main fibre types which contributed to the gross appearance of these fleeces, with, in one of four Merino fleeces analysed, an additional fifth type.

As Prof Barker suggests, the degree or time of shedding of the fibres in the sheep described may throw some light upon its general coat constitution, but it may be questioned whether there is sufficient evidence

forthcoming from differences in fibre pigmentation to warrant their adoption as criteria in the differentiation of species of *Ovis*.

J E NICHOLS.

Wool Industries Research Association,  
Torridon, Headingley,  
Leeds, Feb 3

<sup>1</sup> NATURE, Jan 23, p 128

<sup>2</sup> *Annals of Applied Biology*, 1921

<sup>3</sup> *Jour of Genetics*, 1924, 1926, 1928, 1930, 1931

<sup>4</sup> *Jour of the Textile Institute*, 1927

<sup>5</sup> *Ibid*, 1930

DR NICHOL'S letter confirms the value of the observations on the sheep which I have, simply for convenience, designated *Ovis astore* in my letter in NATURE of Jan 23. I am still in the midst of my investigations into Kashmir wools for the State Government, but there is already evidence that in a certain district all, or nearly all, the sheep carry double-coats of wool.

About 1912 I was associated with the late Prof T B Wood, of the University of Cambridge, in his experiments in crossing Merino sheep with Shropshire. Messrs Bailey and Engledow came to work with me at Bradford and got out possibly the first diameter frequency distribution curves published with reference to wool. These showed two modes giving the suggestion that two types of fibres—Merino and Shropshire—were being grown in the same (crossbred) fleece. Three years ago I also experimented with the Wembley Merino crossed Lincoln wool. On combing this, the 'top' was very like Lincoln wool and the 'noil' very like Merino wool. Iceland wool is noticeable as yielding a coarser outer-coat fibre and a more valuable under-coat fibre. None of these examples corresponds with *Ovis astore*.

I am surprised that Dr Nichols does not cite such a sheep as the Rough Fell sheep, which, about July, shows an outer-coat growth, and at the roots of the outer-coat fibres an under and shorter wool growth. This under-growth, however, is of fine wool, whereas the *Ovis astore* under-growth is of coarse wool and is sometimes pigmented and sometimes white. Possibly Dr Nichols has had this phenomenon under his eyes and missed it, as I did until coming across *Ovis astore*. The Black-headed Persian is much in evidence in Kashmir and is also being used for crossing in South Africa. Among the woolled skins I have from South Africa is that of a Black-headed Persian x Suffolk Down (twice crossed). This shows a pigmented under-growth of strong fibre. Whether there has ever been the outer-growth of strong hair-like fibres or kemp I cannot say, but it is very probable.

Prof Cossar Ewart and myself were among the first to recognise the kemp birth coat of Merino lambs as possibly the outer-coat of the wild sheep, and it may be that *Ovis astore* will bring into prominence the time of shedding of this outer-coat—early or late. The stronger outer-coat of *Ovis astore* certainly seems to correspond with the black outer-coat of the Black Wolf—the phenomenon of growth is apparently the same in both cases.

Dr. Nichols is scarcely kind either to himself or to me in suggesting that I have mistaken a thickening of the normal wool fibre for a stronger under-growth, and a colour-banding of the normal fibre for a coloured under-growth. This latter phenomenon I became acquainted with some thirty years ago, and I have also read and adjudicated upon Miss Boyd's thesis on this subject.

ALDRED F BARKER

The University,  
Leeds

No 3255, Vol 129]

### Inheritance of Milking Capacity

MR MADSEN's letter in NATURE of Jan. 30 contains much interesting information, based, as it is, upon data unusually numerous and comprehensive. It is with regard to his conclusion concerning the evidence of transmission of some factors for milk-inheritance in a sex-linked manner, based upon the difference in the correlations of the sires to their paternal grand-dams (0.026) and their maternal grand-dams (0.112), that I should like to make two points.

(1) The small correlation to the paternal grand-dam (0.026) might be explained by the choice of the sires by genotypic rather than by phenotypic methods, the merits of the progeny test having been for some time widely recognised in Denmark. The insufficiency of a single cow's record (because it is the expression of a phenotype) in foretelling the production of her progeny, has been stressed by many investigators, and it is doubtful if one should expect to find a significant difference in the correlations of two such records diluted through three generations.

(2) The difference between the correlation coefficients, 0.026 and 0.112, is not significant. From the data tabulated it appears that such a difference would be likely to occur by chance once in ten times. The odds are, therefore, not great enough to warrant the postulation of sex-linkage for some factors, from the data used.

J EDWARDS  
School of Agriculture,  
University of Cambridge, Feb 5

### Contact of Smooth Surfaces

As the result of experiments described in the December number of the *Proceedings of the Royal Society*, Messrs Bastow and Bowden conclude that "When a finely polished plate is lowered on to another polished surface the top plate will sink until the two surfaces are in close contact. The apparent 'floating' at a height of  $4\mu$  is due to dust or particles between the plates." The implication is that the floating is due to particles with a diameter approximating to  $4\mu$ . With the conclusion I agree, since, in spite of many attempts, I have never succeeded in reproducing Sir William Hardy and Miss Nottage's results with carefully cleaned surfaces, with the implication I disagree entirely. In the case of metal plates, the somewhat elaborate apparatus used by Messrs Bastow and Bowden is quite unnecessary. All that is required is to clean the plates with reasonable care, exposed to the air of the room, and lay one on the other as gently as possible. It will then be found that they are in electrical contact.

In my experience<sup>1</sup> it is only with slightly contaminated surfaces that the floating effect is observed, but the point is that the thickness of contaminant is far less than the distance between the plates. When artificial 'dust' in the form of glass fibres is introduced into the gap, the width of the latter increases and is greater than the thickness of the fibres. A film of grease  $1\mu$  in thickness is easily visible on a polished plate, while fibres  $4\mu$  in diameter can be seen without particularly good eyesight. Messrs Bastow and Bowden have made no measurements of the size of the 'dust' which they were 'sometimes' able to see. Surely they do not accuse former workers on this subject of such carelessness that they failed to observe particles  $4\mu$  in diameter, yet if they admit that floating is due to particles of smaller size, the problem remains *in statu quo*.

H E WATSON  
Indian Institute of Science,  
Bangalore, Dec 31

<sup>1</sup> *Proc Roy Soc, A*, 123, 195, 1929

THE experiments described in our paper have shown that small polished plates, *whether clean or contaminated by vapours or liquids*, approach within about 0.3 microns when brought gently together in a dust-free atmosphere. Clean plates showed the same separation *in vacuo*, and this distance corresponded with the known limit of flatness of the plates. Later experiments with polished glass plates up to 10 cm in diameter have confirmed this conclusion, since, when placed together gently in the air of the laboratory, they frequently showed first order interference colours and a mean separation of about 0.3 microns. The exact separation under these conditions depended on the amount of dust present in the atmosphere, but it was seldom as great as 4 microns. There was no evidence for 'floating' either with clean or contaminated surfaces.

In Prof. Watson's experiment, two glass fibres 2.8 microns in diameter were laid on a polished steel plate and a polished steel cylinder placed on top. Instead of sinking down to within a distance of 2.8 microns, the cylinder appeared to float in the air at a height of 15 microns above the plate. After 'prolonged tapping', the air gap decreased to 6.36 microns, but the cylinder would sink no lower.

We have repeated this experiment, using glass surfaces and fibres 1 to 2 microns in diameter. When the fibres were short, there was no 'floating', the separation was equal to the diameter of the fibres. When they were longer than a few millimetres, the separation was frequently as great as 15 microns, but an examination of the fibres showed that they were obviously crinkled. The amount of separation decreased with tapping, and depended simply upon the size of the crinkles.

It is, of course, impossible for us to say whether the same factor was or was not responsible for the large separation recorded by Prof. Watson, but, until there is some convincing evidence for 'floating', we consider that any separation between polished surfaces which exceeds the limits of flatness of the plates by more than a few molecular diameters must be attributed to something much more concrete than a mere cushion of air.

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#### Apparent Formation of Copper Carbonyl

AN interesting observation has been made in the laboratory of the Department of Chemistry here on the apparent formation of copper carbonyl in the synthesis of methanol using certain catalysts containing copper.

It was noted that the passage of either hydrogen and carbon dioxide, or water gas, over a catalyst containing equal parts of copper, aluminum, and zinc, produced a liquid condensate which was quite colourless when blown from the high-pressure condenser. However, in a short time, apparently dependent upon the amount of water in the liquid, an evolution of gas occurred which was accompanied by the formation of a yellowish precipitate. Qualitative tests showed that copper was the only metal in this material. The precipitate appeared to be semi-colloidal in nature and was readily soluble in hydrochloric acid, which suggests that the copper was present as a hydrated oxide. This was further demonstrated by the results obtained using hydrogen and carbon dioxide, in which case the liquid contained equal amounts of water and alcohol, and precipitation occurred almost instantaneously upon removal of the pressure. Numerous other catalysts investigated did not show the phenomenon.

The possibility of this precipitate being formed by the hydrolysis of a copper salt formed in the reaction chamber is precluded by the lack of acidity in the condensate. If the evolution of gas were due to the release of pressure, this would occur at once and not after an induction period, as was the case with the water gas condensates. It was further observed that evolution was greatly stimulated by the addition of water, acid, or alkali to the condensates, and even after boiling an alcohol condensate, evolution could be obtained by the addition of water. Such phenomena seem to indicate the presence of a compound with similar properties to those expected of a copper carbonyl.

The analysis of the gases evolved by the liquids was not particularly enlightening, due to the complications added by the solubility of the gases in the liquid. Usually about 1 c.c. of gas was given off by 3 c.c. of liquid, and the composition varied greatly. Carbon dioxide was usually high, averaging about sixty per cent, but fell as low as 10 per cent, carbon monoxide averaged about 17 per cent, but was as high as 80 per cent on one occasion. Hydrogen was invariably low, while hydrocarbons accounted for a fairly constant value of 18 per cent. Interpretation of these results is extremely difficult.

Bertrand<sup>1</sup> claimed the formation of a copper carbonyl at atmospheric pressure, but Mond and Heberlein<sup>2</sup> were unable to verify this result. In our experiments with the above catalyst at atmospheric pressure and various temperatures there was no evidence of the formation of a carbonyl. However, pressure should favour such a reaction, and the product, apparently unstable at atmospheric pressure, would decompose as observed.

The experimental results indicated that the greater the amount of copper precipitated from the condensate, the greater was the activity of the catalyst. If this compound were an intermediate in the formation of methanol, such a result would be expected.

The formation of such an intermediate and the observance of carbon monoxide in the exit gas in the experiments involving carbon dioxide and hydrogen offers a new view on the mechanism of methanol formation which will be discussed elsewhere.

E. H. BOOMER  
H. E. MORRIS  
G. H. ARGUE

University of Alberta,  
Edmonton, Alberta, Canada,  
Jan 26

<sup>1</sup> Bertrand, *C. R.*, 177, 977, 1923

<sup>2</sup> Mond and Heberlein, *J. Chem. Soc.*, 125, 1222, 1924

#### Trail of Bright Fireball of Feb. 24

ON Feb. 24, at 20<sup>h</sup> 41<sup>m</sup> GMT, a brilliant fireball passed over West Lancashire from south to north and was observed by many persons who have communicated their observations to me. I did not myself see the object, as I was in the Observatory exposing a plate for experimental purposes on the nebula in Orion, but I noticed the sudden brilliant illumination of the sky and the interior of the Observatory, and made a note of the time. On developing the plate next morning I found that the trail of the meteor was recorded on it, as shown on the accompanying print (Fig. 1).

The path of the meteor is very well defined, making an angle of 35° west of north with the declination circle of the nebula at the time of passage of the meteor. The trace shows well-marked periods of incandescence, and the brilliancy was obviously increasing rapidly during the interval of passage of the object across the portion of its path recorded on the plate, which is of a length of about 8°. This appears



to indicate that the point at which the meteor first became luminous would be not much to the south-east of the nebula.

The accounts received are for the most part descriptive of the appearance of the object which had a brilliant bluish-white head, followed by a tail of considerable length, tapering to a point, and emitting showers of bright sparks. One or two observers note the appearance of brilliant prismatic colours in the part immediately behind the head. Information as to the apparent altitude above the horizon is lacking, but the track on the plate indicates that the meteor would pass a little above the Pleiades. From observers at Blackpool and Fleetwood it appears that the meteor passed a little to the east of the zenith in the former place, and a little to the west at the latter. From this it is deduced that the path of the meteor was approximately N 5° E, passing slightly east of

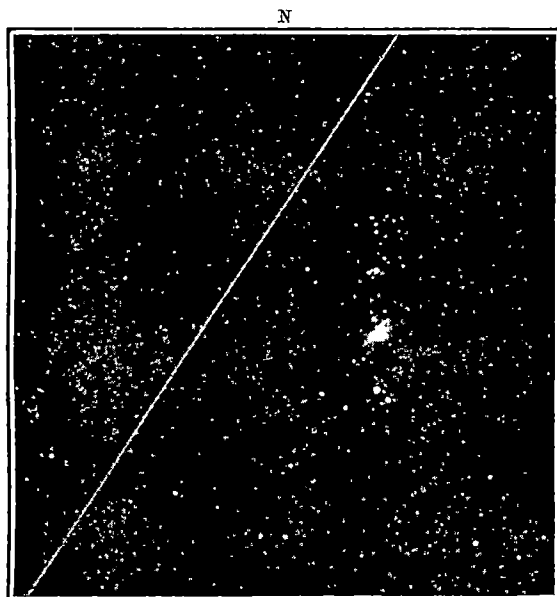


Fig 1

Blackpool, a line which produced southwards passes approximately over Chester, Hereford, and Bristol—but no information has been received indicating from how far south the meteor was visible.

Owing to the absence of reliable altitude observations, it is not possible to make an accurate determination of the height above the ground, but, taking more or less probable values, it may have been between 15 miles and 25 miles above Blackpool. If sufficient data come to hand to determine an accurate projection of the track on the earth's surface, measurement of the plate will enable an accurate determination of the height and inclination of the path to be made at points near the beginning of the track.

J P ROWLAND, S J

Stonyhurst College Observatory,  
Nr Blackburn, March 9.

#### The Voyage of the *Beagle*

IN the account of the voyage of the *Beagle* in NATURE of Dec 26, 1931, there is a small point that requires correction. This relates to the first appearance of the title-page "Journal of Researches" in Darwin's publication.

His "Journal and Results" appeared as vol 3 of FitzRoy's "Narrative" in 1839, as stated in the article, the publisher being Henry Colburn. The demand for

Darwin's volume was immediately in excess of that of its companions, and Colburn therefore brought out in the same year a separate issue of vol 3. Several preliminary leaves were omitted, and the title under discussion was introduced for the first time. The new title-page reads as follows: "Journal of Researches into the Geology and Natural History of the various countries visited by H M S *Beagle*, under the command of Capt FitzRoy, R N, from 1832 to 1836." Some copies were also issued bearing the date 1840.

In Murray's second edition of 1845, the title-page of the second issue of 1839 was retained with slight alterations. 'Geology' and 'Natural History' were reversed in order, perhaps corresponding with a parallel reversal as to their relative degrees of importance in the author's opinion. The title-page in its altered form runs: "Journal of Researches into the Natural History and Geology of the countries visited during the voyage of H M S *Beagle* round the World".

With regard to Colburn's dealings, the following letter from Darwin to his sister, written in Feb 1842, gives some indication: "Talking of money, I reaped the other day all the profit I shall ever get from my Journal, which consists in paying Mr Colburn £21 10s for the copies which I presented to different people—1337 copies have been sold. This is a comfortable arrangement, is it not?"

Mr Geoffrey Keynes has helped to elucidate the problems of the issues of the first edition, and I am indebted to him for having shown me a copy of a German translation that appeared in 1844, a year before real popularity was attained in England by Murray's second edition. I find that this publication is mentioned in "Life and Letters", vol 1, p 323, where the following quotation is given: "I must, with unpardonable vanity, boast that it was at the instigation of Liebig and Humboldt."

N BARLOW.

Boswells, Wendover

#### Ancient Windmills

WITH reference to the letter under the above heading by Mr H P Vowles in NATURE of Feb 27, p 317, there is in this library a copy of a Chinese work entitled "Ch'i Ch'i t'u Shuo" ("Record of Strange Machines from the West"), which is probably the source of the Chinese illustrations of machines referred to by Mr Vowles. The book, which is on applied mechanics, was compiled in 1627 by Wang Cheng, a Christian convert, and contains fifty-four illustrations of machines, windmills, etc., which appear to have been copied directly from the sixteenth century sketch-books of Besson (1569), Ramelli (1588), and Veranzio (1595).

Our copy of the book was actually printed ("newly engraved") in 1829, but it contains prefaces dated 1627 by Wang Cheng, 1629 by one of Wang's pupils, and 1829. Whether these actually represent three separate editions of this particular work is doubtful, but the same illustrations appear in the great Chinese Encyclopædia of 1726 to which Mr Vowles refers. The interesting point is that Wang Cheng says he compiled the book from information supplied by the Jesuit missionary, John Terrence (1576-1630), who went to China in 1620 and remained there until his death. He was a noted naturalist and mathematician.

The book was exhibited at a meeting of the Newcomen Society in 1925 (*Trans Newcomen Soc*, 6, 85).

ALLAN GOMME

The Patent Office Library,  
London, W C 2, March 5

## Research Items

**Human Hair and Primate Patterning**—A study of the puzzling problems presented by the human hair has been made by Dr. Gerrit S. Miller and is published by the Smithsonian Institution (*Misc. Coll.*, vol. 85, No. 10). Most solutions offered assume tacitly that all the peculiarities of the human hair arise from man's special constitution and its reactions to the natural environment or to the artificial conditions that man has imposed upon himself, for example, that bareness of skin comes from the habit of wearing clothes, that baldness comes from barbers and wearing hats, that greyness is due to the lessening of bodily energy which goes with increasing civilisation and 'domestication', and so forth. These solutions do not take into account the zoological possibility that many features of the human hair may be generalised primate traits instead of specifically human developments. In other words, they may be special examples of 'patterning', a tendency which attains its greatest development in the primates. Human hair patterning shows itself more conspicuously in the head than on the limbs and body. It is not exactly duplicated in the head of any of the other primates, but all the elements can be found rarely in non-human members of the tribe. In man, both sexes have certain elements in common, but the females' pattern differs in the extension of the bare area over the whole of the base and the sides of the face. The first step in baring the forehead is shown in one of the Celebean macaques, while the essentially human forehead can be seen in the orang. Among non-human primates a bare or nearly bare area round the mouth is usual, while the extension of the bare area to the cheek is seen in the great apes. Yet some, such as the orang and the African guenon, have a beard like a male Caucasian or an Australian. Similarly, baldness, turning grey, and other features, as well as racial differences in man, can be shown to be instances of patterning.

**Contact Modifications in Language**—M. A. Meillet, in a study of the modifications which result when a people changes over from one language to another (*Scientia*, vol. 5, Jan. 1932), points out that the student of the history of languages who confines his attention solely to the language which has survived runs the risk of over-simplification. A language may preserve intact the linguistic type of the tongue from which it derives its morphological characters, as the morphology of the French language contains no elements which are not derived from the Latin, and yet show the effect of influences to which it has been subjected. In the area that is now France two changes of tongue have taken place within historic times. Further, there are elements in French which can be explained as belonging to neither the Gallic nor the Latin tongues, they must be derived from a language spoken before the introduction of the former in the millennium before Christ. One of the effects of the introduction of Latin into Gaul was that a considerable proportion of the population must have become bilingual, and a second period of bilingualism followed after the invasion of the Franks. Of the latter there is evidence in, for example, the inverted form of interrogation after the German model "Kommt er?", the use of *on* = *man*, the use of *rien* from Latin *rem* = *nicht*, the retention of *h*, features none of which was present in Latin. A second modification was the use of one language to express the mode of thought of another, as at the present day in certain localities German thought is expressed in a Slavic language. There is also the

matter of accent, as the Provençal retains the Provençal or Gascon pronunciation of the vowels as opposed to the standard of Paris and the north. Further, tendencies in the earlier language may be inherited and influence the development of the derivative language. Thus certain progressive modifications observed in the Celtic tongue seem to have been carried over and to appear as tendencies influencing the development of French.

**Four-Tusked Elephants**—During recent years there have been several newspaper discussions regarding the possible occurrence of large elephants with four tusks. Field observation tended to show that a few such specimens had been seen. J. G. Dollman has now revised the whole question (*Nat. Hist. Mag.*, Jan. 1932), and shows that various examples are known of abnormally grown tusks, which, springing from a single root, have split into several branches, sometimes quite distinct from one another. Sir Frank Colyer has suggested that sometimes such abnormal growth may have arisen from a divided tooth germ, and that many are doubtless due to injury of some sort—the passage of a bullet or the splitting of the tusk during the prising up of a tree root. It seems likely that such cases may parallel the cases of four-tusked elephants which have been recorded in the field, and that a true duplication of tusks (although mirrored duplication is a common enough form of abnormal growth amongst some animals) has so far not been proved for the tusks of an elephant.

**The Elutriator in Biology**—The *Proceedings of the Lynnean Society of London*, part I, 1931-32, contains a brief account of Mr. A. G. Lowndes's paper on the possibilities of the use of the elutriator in biology. This simple instrument depends on the use of different velocities of water current to effect a grading and separation of the finer particles of a powdered substance, but it is obvious that the method has considerable possibilities in comparing the swimming powers of various fresh water organisms. Mr. Lowndes describes the behaviour of various organisms he has studied. Two species of *Daphnia* with different powers of swimming could be completely separated in the elutriator, and the method would seem to have a wide range of usefulness, both in separating the organisms from mud or silt and in effecting some separation of the organisms from one another. It may also provide a useful method of studying the behaviour of various organisms which attach themselves to a substratum in various stream strengths.

**Research on Tobacco**—In the fifty-fourth Report of the Connecticut Agricultural Experiment Station (*Bulletin* 326) an account is given of experiments dealing with various aspects of the tobacco industry. The practice of topping and suckering the plants is recognised by growers as producing better leaf growth, and the investigations showed that these processes, if properly carried out, would also accelerate the ripening of the leaves, reduce the liability of the plant to wilt and encourage root growth. Tobacco normally produces large numbers of seeds per plant, and the ease with which sufficient seed is obtained has led to a lack of attention being paid to its quality. Trimming the inflorescence, however, so as to allow only a limited number of pods to develop, was found to result in an increase in the weight of seed produced. Leaving some of the upper leaves on the stalk until the pods were mature had a similar effect, and since the

first formed pods in the centre of the inflorescence yielded the heaviest seeds, their selection is recommended. A study was also made of the effect of temperature and humidity on the rate of the process of curing and the quality of the final product. Relative humidities less than 70 per cent or more than 90 per cent were found unsuitable, the best results being obtained with 80-85 per cent humidity at a temperature of 95° F for early and 85°-90° F for late pickings.

**Algæ in the South Indian Cretaceous**—Mr L. Rama Rao, Central College, Bangalore, recently recorded the occurrence of *Lithothamnion* in some of the limestones of the South Indian Cretaceous (NATURE, 128, 225, Aug 8, 1931, 128, 873, Nov 21, 1931). He has since sent a further communication, in which he says he has now recognised algæ in the flints and cherts of the Niniyur (Damian) stage—especially in a band of flints from about a mile south-east of Sendurai. Some of the flints are 'pebbly', nearly 2 cm in diameter, and, under the microscope, are seen to consist of patches of algæ. Others, which are more massive, reveal broad patches of algæ. *Lithothamnion* is common, while several other types of algæ occur. Before silicification, the rock appears to have been largely of the nature of an algal limestone.

**Sedimentation in Coral Reef Regions**—The rate and nature of the sedimentation in coral reef regions is of importance with regard to their formation, and has been the subject of careful studies by Mayor, Vaughan, and others. The latest research is by S. M. Marshall and A. P. Orr, published by the British Museum (Natural History) in vol. 1, No. 5, of the *Great Barrier Reef Reports*. Bottles were placed down on the surface of the reef in different positions and in the anchorage to 3.6 m. Their contents were collected weekly, the contained sediments weighed and graded into size percentages. The loss by solution in 1 in 3 hydrochloric acid in the different grades was calculated, together with the further loss by ignition, and the ash residue. The percentage of the latter is small in the larger grades of sediment, but in the smallest shows varying amounts, 8-29 per cent. It is not clear whence this ash is derived. Almost the only organic material in the same are the frustules of diatoms, the bulk of the ash presumably being carried in suspension from the neighbouring high lands. Three hand borings were driven down to 15 ft through the surface of the reef, and showed mud with little sand below 6 ft. This result was unexpected, the coral reef being a mere capping of a mud shoal. The ash in this mud varied up to 37 per cent, increasing in amount with depth. The last part of the paper contains experiments as to the effect of sediment on living corals. These show that the reef corals when helped by water movements are able to deal with any ordinary amount of mud or sand falling upon them. Coral colonies with large polyps and branching corals are best able to clean themselves, the immense *Fungia* polyps when buried from above almost seeming to "climb through 6 cm of sand unaided." Ordinarily, sediment coming from below, due to movement of sand along the reef surface, "kills in a day or two all the polyps thus covered." We are hence driven to conclude that in protected situations within reefs there is little likelihood of coral colonies being killed by the deposition of sediment. Another explanation thus becomes necessary to explain the barrenness of such areas so far as coral growth is concerned.

**Displacement Pumping of Oil-wells**—The evolution of production methods as applied to lifting oil from the

reservoir after it has ceased to flow naturally has been marked by stages in which ordinary pumping, bailing, and swabbing have gradually given place to gas lift, at least in the penultimate phase of oil-well history. The effect of gas lift is to postpone the time when it is necessary to put the well 'on the beam', as it is termed, that is, the recovery of oil by direct pumping. Actually gas lift is practicable from the first sign of initial decline of oil-flow in the well until either running pressure and rock pressure are equal or until input oil to gas ratio becomes such that the practice has to be discontinued for economic reasons. In the circumstances the search has been for a method which would practically eliminate pumping altogether, for some mechanism which would make it possible to produce oil from the well by appeal to compressed air or gas when other forms of gas lift were impracticable. Displacement pumping, using air, has been known as a hydraulic process for raising varying quantities of fluid over moderate lifts for a long time, the 'displacement pump', of a type now adapted to oilfield work, is a comparative new-comer in this field, the operating medium being either gas or air. It is claimed that this method of bringing oil to the surface is practicable until the well has entirely exhausted itself, to the exclusion of the direct pumping stage altogether. A great deal of experimental work has been done in achieving this notable result in oil-well engineering, and the Institution of Petroleum Technologists was fortunate in learning about displacement pumping from such an able exponent of production technique as Mr Albert Millar, whose paper was read on Feb 9.

**Artificial Disintegration of Aluminium**—The fields close to atomic nuclei can be investigated both by experiments on the scattering of  $\alpha$ -particles and by experiments on artificial disintegration. In the case of aluminium, data obtained in both ways now exist, and are summarised and discussed by J. Chadwick and J. E. R. Constable (*Proc. Roy. Soc.*, Feb). The scattering experiments, due to Riezler, fix the extension of the region within which  $\alpha$ -particles are attracted by the nucleus and the height of the potential barrier at this point at about  $5 \times 10^{-13}$  cm and 8 million electron-volts. Chadwick and Constable's extensive new experiments on the disintegration of aluminium by the  $\alpha$ -particles from polonium show that within this barrier there are at least four energy levels into which  $\alpha$ -particles can be captured. Their value is in the neighbourhood of five million electron-volts, and each is associated with the ejection of two groups of protons. The same picture also accounts for the production of  $\gamma$ -rays when aluminium is bombarded by the  $\alpha$ -particles from polonium, and predicts that their energy should be about 2.3 million electron-volts, which is identical, within the limits of experimental error, with the results of the direct observations of Webster.

**Moving Coil Reproducers and Flexible Disks**—Dr N. W. McLachlan has recently discussed details of moving coil reproducers (*Phil. Mag.*, Jan 1932). He determined the modulus of elasticity of paper and used it to compare the stiffness of conical sheets and disks of the same radius. The combination modes of a reed-driven paper disk are determined, and a comparison with theory shows that the paper must be heterogeneous. The exact solution for a reed-driven disk vibrating in a vacuum without loss is found. The case of a coil-driven circular aluminium disk was examined experimentally, and it was shown that the frequency band occupied by the first symmetrical mode is only five cycles. With constant current in the coil the output at resonance is about

two thousand times greater than at non-resonant frequencies. The author analyses the influence of the magnetic field upon the output and upon the coil impedance of the reproducer. It is shown that the oscillation of a coil driven by an alternating current in a non-uniform magnetic field is accompanied by a motion of translation, and he points out that this is akin to the process of the rectification of an alternating current. A series of impulse records is shown giving the natural damped oscillations of moving coil reproducers of the horn and large diaphragm kind. He deduces that their field of utility lies in the determination of the main symmetrical mode in the upper register and the low-frequency modes associated with the 'surround' constraint.

**Physical Properties of Nitrobenzene**—Mazur has reported (*NATURE*, 126, p 993, 1930) a sharp fall in the dielectric constant of nitrobenzene, an arrest in the heating curve (*ibid.*, 127, p 741, 1931), and a sharp change of slope in the density-temperature curve (*ibid.*, 127, 893, 1931) at a temperature about 4° above the melting point, and the inference to be drawn from these results would be that there are two forms of liquid nitrobenzene. Massy, Warren, and Wolfenden (*J Chem Soc*, Jan) describe experiments on the viscosity and density of nitrobenzene at various temperatures which show no such discontinuities. The density curve is a perfectly straight line and shows

no trace of the discontinuity reported by Mazur. Since the dielectric constant is intimately connected with the degree of orientation and capacity for free rotation of the dipoles of the medium, it is to be expected that the viscosity curve should show a break corresponding with the break in the dielectric constant curve reported by Mazur. Here again no trace of a break was found, the curve being a straight line.

**Kolbe's Reaction**—The mechanism of the formation of hydrocarbons by the electrolysis of salts of organic acids, discovered by Kolbe in 1849, has been the object of a considerable amount of investigation. On electrolysis of potassium acetate solution, for example, ethane and carbon dioxide are formed. Matsuda (*Bull Chem Soc Japan*, Jan) finds that an oxidising substance is formed during the electrolysis, which he identifies as hydrogen peroxide. He considers that acetyl peroxide is the primary product of the reaction at the anode, most of it being decomposed in the earlier stages of the electrolysis as follows:  $(\text{CH}_3\text{COO})_2 = \text{CH}_3\text{CH}_3 + 2\text{CO}_2$ . It may also be hydrolysed into peracetic acid and acetic acid, or into hydrogen peroxide and acetic acid. The hydrogen peroxide will be decomposed in the alkaline solution, so that its amount will begin to decrease at a certain point in the electrolysis. The relation between the formation of hydrogen peroxide and the pH value and concentration of the solution were studied.

### Astronomical Topics

**Geological Studies of the Moon**—The surface of the moon is now known in such detail, thanks to excellent photographs and persevering telescopic study, that it is possible for the geologist to trace the steps of the formation of many of the features. Prof. O. Matousek, of the Charles University, Prague, read a paper a year ago before the Geological Society of America, which is printed in the *Pan-American Geologist*, vol. 54. The Sinus Iridum is the region examined; a diagram shows the various systems of faults, which divide themselves into groups in various directions, the parallelism of each group being very close. Two remarkable dislocations are indicated, in each of which a large region appears to have suffered a lateral shift of several miles. One is in the eastern cape, Heraclides; this is sometimes compared to a woman's head, the portion corresponding to the face has been shifted towards the north-west. The other dislocation occurs in the middle of the coastline of the bay, producing a conspicuous little promontory. Several of the faults are marked by rows of small craters, and the author considers that in these cases at least the craters are genuine volcanoes.

Another diagram shows a vertical section of the bay, the strata being arranged in a manner deduced by the author from a study of the faults, which appear to have caused vertical displacements as well as horizontal ones. The floor of the bay is supposed to be the result of a great lava inundation.

Mr. W. Goodacre read a paper at the February meeting of the British Astronomical Association on a long cleft which he has detected in the south-east region of the Mare Humorum; it does not appear to have been noticed before. It is probably a similar formation to some of those studied by Prof. Matousek.

**Spectra of B-type Stars**—A useful contribution to the study of stellar spectra of type B has been published by Dr. O. Struve (*Astrophys J.*, 74, 225). Thirteen stars, covering all the sub-types from  $O_6$  to  $B_8$ , have been investigated for the purpose of obtaining

a reasonably complete list of wave-lengths and origins of absorption lines in these stars. A list is given of 379 lines between  $\lambda 3820$  and  $\lambda 4924$ , of which 130 are newly identified with known elements. Only 73 still remain unidentified. Wave-lengths are given to 0.01 Å, and origins (in the case of blends) appear in the order of probable importance of the components. Estimated intensities on an arbitrary scale of 1 up to 10 (excluding hydrogen lines, which may be so high as 50) are given for ten typical stars. An investigation is also included of the contours and intensities of the helium lines. Both neutral and ionised helium lines show an expected broadening by the Stark effect, but the relative intensities of He I lines vary in a curious manner. The intensity ratio singlet/triplet is at a maximum at type  $B_2$ , decreasing both towards type  $O$  and (more slowly) towards type  $B_9$ .

**Annuaire Astronomique Camille Flammarion**—This attractive annual (Paris: Ernest Flammarion, 1932, 12 francs) is full of useful information. There are sunspot statistics from the beginning of the century; ephemerides and other information about the planets—it is well to point out that the ephemeris for Pluto, quoted from *Lock Bulletin*, is for the equinox of 1900, this is not stated in the *Annuaire*, the correction for precession is  $1\frac{1}{2}$  minutes of time, which would cause difficulty in identifying such a faint body. An omission in the diagram of future eclipses may also be pointed out, this extends to 1950, but omits the important Norwegian eclipse of July 1945. There are diagrams of the important occultations of the year, which include several of the Pleiades and one of Regulus. There are also tide tables, and comet statistics, which are kept up to date by M. F. Baldet. The stellar information is very full, there are reproductions of stellar spectra, and diagrams of the light-curves of variables. There are star maps for each month, with notes on the phenomena of each month. The book deserves a place on every astronomer's table.

## Ice and the Formation of Alpine Scenery\*

THREE dates stand out as landmarks when a special revival of interest in Alpine glaciology occurred—namely, 1840, when Jean Agassiz published his “*Études sur les Glaciers*”, 1862, when Ramsay read his paper on the glacial origin of lakes to the Geological Society and Tyndall published his paper in the *Philosophical Magazine*, in which he advocated a glacial origin for the Alpine valleys, and 1900, about which time Peach described the Alpine trough-valleys, and W M Davis emphasised the glacial overdeepening of the Ticino Valley, and when, a little later, Penck and Brueckner completed their monumental work on the ice age in the Alps.

It is not until the advent of the eighteenth century that we find any interest being taken in glaciers, then Scheuchzer, between 1706 and 1723, published various works on the natural history of Switzerland which contained some glacial observations, and in which he propounded the dilatation theory of glacier motion. He was followed by Gottlieb Gruner, who in 1760 published his “*Eisgebirge*”, in which he describes the alternate advance and retreat of glaciers, illustrated by an account of the measurements of the Grindelwald Glacier between 1540 and 1750. De Saussure, between 1779 and 1796, published his famous “*Voyages dans les Alpes*”, in which he defined the term ‘glacier’ and classified glaciers under three orders, in this work he also described *roches moutonnées*, which he attributed to water action, and he ascribed the transport of erratic blocks to a deluge or catastrophe. Though usually credited with the view that glaciers moved as solid bodies, his description of the Mount Dolent Glacier as moulding itself to the form of its valley shows that he recognised the plasticity of ice.

In the first half of the nineteenth century a new impetus was given to glacial studies by the observations of Schimper and Esmark and the writings of Venetz, Charpentier, and Agassiz, all of whom attributed the transport of the famous erratics now found on the Jura to the former greater extension of the present glaciers. This view had, however, been anticipated by Hutton.

\* Substance of the presidential address by Prof. E. J. Garwood, F.R.S., before the annual general meeting of the Geological Society of London on Feb. 19.

The publication of Agassiz’s “*Études sur les Glaciers*” did much to stimulate further observation on glacial phenomena during the next few years, but interest again waned after Agassiz’s departure for America.

Ramsay’s paper to the Geological Society in 1862 created renewed interest, fostered by Tyndall’s views on the glacial erosion of Alpine valleys, and discussion was now directed to the work of ice as an erosive agent. Writers on this subject were divided into two camps. Whereas Wallace, Jukes, the brothers Geikie, Logan, Steenstrup, and Penck supported Ramsay, others, including Murchison, Lyell, the Duke of Argyll, Bonney, Rutimeyer, Heim, Credner, and Desor attributed but little erosive action to glaciers.

By the beginning of the present century most observers admitted some erosive action to ice, and more detailed observation focused attention on special features of Alpine scenery. Penck described the trough-shaped characters of Alpine valleys, and Prof. W. M. Davis attributed the hanging valleys and truncated spurs in the Val Ticino to the formation of the trough by glacial overdeepening. The origin of cirques was also discussed and was variously attributed to glacial erosion, water action, and frost action on the cirque wall. The work of Penck and Brueckner had established the occurrence of four glacial and three interglacial periods in the Alps, chiefly on the evidence of the deposits, and the benches which occur on the valley flanks confirm this conclusion. The truncation of the overlapping spurs which occur in the trough valleys shows, however, that the overdeepening must have been largely the result of river erosion during the last interglacial period, the valley having later been widened and modified by glacial action. Certain features, namely, the *arêtes*, cirque floors, the steep south side of the Alps, and in part the hanging valleys, appear to owe their special features to the relatively protective character of ice. The steps in the main and tributary valleys present special difficulties, and cannot be satisfactorily accounted for by simple glacial erosion. They appear to be due in some way to the alternation of glacial and interglacial periods, and may possibly also be due to protection by glaciers during interglacial periods.

## Past and Present Whaling Records

IN the whaling ports which furnished the fleets of the nineteenth century lie many log-books containing records of long years of whale fishing. Charles H. Townsend has struck upon the happy idea of using the old records (in New Bedford Public Library alone there are hundreds of log-books) to obtain information regarding the great whaling grounds, the numbers of whales slain, the position and month of capture, and so on (*Bull. New York Zool. Soc.*, Nov.-Dec. 1931, p. 173).

There are several important collections of whale-ship logs at Nantucket, Salem, and other New England ports celebrated in the history of the whaling industry, but these first records are drawn only from the New Bedford logs and refer only to the sperm whale. Nevertheless, the number of sperm whales represented by the plottings upon the chart accompanying the paper is no less than 11,026. The ‘whaling grounds’, including twelve in the North Atlantic, were visited during fairly definite seasons, as the plottings which

record the position and month of each whale capture show.

In the North Atlantic the plotted areas above latitude 25° show the presence of whales, with few exceptions, during the April-September period, and in the Sargasso Sea the killings are almost wholly confined to the summer period of the northern hemisphere. Between lat. 25° N and the equator, whales were taken chiefly during the October-March season, and along the coast of South America and towards the Cape of Good Hope the catches were largely made during the same season, or summer time in the southern hemisphere. Off Japan and along lat. 30° N the period changes to the April-September season. In the Pacific and to some extent also in the Atlantic Ocean, catches for all months are recorded along the equatorial belts, and the cool Benguela and Humboldt Currents had the effect of creating all-the-year whale fisheries off the west coast of Africa and in the neighbourhood of the Galapagos Archipelago.

It must be remembered that whaling in itself was not a seasonal trade, but that the whalers made voyages lasting from two to four years, catching whales wherever they could, so that the seasonal distribution of the catches of sperm whales is the more significant. The author promises to publish further plottings of sperm whale records and of records of five other species of whales from logs still unexamined, and the results of his investigations will be looked for with much interest.

Records of present-day whaling are giving rise to serious conjecture with regard to the preservation of the number of whales. The number killed during the season 1929-30, according to the *Norwegian Whaling Gazette*, reached the record of 38,563 individuals. Of these, 19,080 were blue whales, 14,350 finners, 1923 humpback, 922 sei, 1352 sperm, and 936 other species. Of the total number, by far the greatest proportion was taken in antarctic waters, 30,654, Japanese waters followed with 1714, and the remainder were captured in

tropical and northern seas. The whaler *Lansving* itself had a catch of 300 whales, shore stations in Alaska and British Columbia had 675. The slaughter of whales has become a much intensified process in recent years. The Norwegian antarctic whaler *Sir James Clark Ross* had seven steam whale-killing boats, a crew of 245 men, and had taken during the season 1445 whales, yielding 55,000 barrels of oil, which were sold to a soap-making firm at an estimated value of one and a half million dollars.

The total world-yield of whale-oil for the season exceeded 3,427,000 barrels, so that, through over-production, much oil had to be stored, and as a consequence there is a slackening off in whaling during the present season. It is a relief to know that the whales will suffer less during a season, but even a years' total respite would help little towards the preservation of slow-breeding creatures like whales, in face of the capacity for slaughter of the new whaling craft.

### Chinese Materia Medica

IN an article in *NATURE* of June 7, 1930, a description was given of the progress that is being made in the elucidation of the botanical origin of Chinese vegetable drugs, and it was pointed out that what might at first sight appear to be a peculiarly abstruse investigation, in which medical historians and anthropologists alone could be concerned, has resulted in a revival of interest in *Ephedra* and the use of its principal alkaloid, ephedrine, in the treatment of asthma.

Prof. Bernard E. Read, to whose labours this practical outcome was mainly due, is continuing these studies, and has published in recent issues of the *Peking Natural History Bulletin* a series of papers on Chinese drugs of animal origin, which have now been issued as a reprint. In preparing these papers, the author has had at his disposal specimens and notes of work done on Chinese materia medica at the Severance Union Medical College, Seoul, and the results of an attempt made by Miss Blanche Wu of the Department of Biology, Yenching University, to arrange the whole fauna used in Chinese medicine according to a modern scientific classification. There is, however, so much unidentified material that such a classification is still impossible.

The subject-matter is arranged in five sections: Domestic Animals, Wild Animals, Rodents, Monkeys and Supernatural Beings, and Man as a Medicine. In each of these sections the particular animals furnishing the drugs are dealt with, and much time and trouble has clearly been expended in relating the Chinese symbols and names to their precise English equivalents. The Chinese doctor was, and probably still is, quite catholic in his taste for drugs, and the article on the pig is reminiscent of the Chicago pork factory, where everything was used but the squeak. This catholicity is not confined to the parts of an animal used, but applies equally to the species regarded as coming within the scope of practical medicine, for man himself figures prominently as a source of drugs. In this respect Chinese medicine is no worse, as Prof. Read points out, than European medicine was in the sixteenth century, and, as he pleasantly puts it, the feverish activity with which every type of animal tissue is being examined for hormones, vitamins, and other specific agents for the treatment of disease "compels an open mind that one may reach beyond the unæsthetic setting of the subject to things worth while." T. A. H.

### Forms of Communal and Industrial Waste

A PAPER read by J. L. Hodgson before the Royal Society of Arts on Jan. 20, discussing "Some Aspects of the Problem of Industrial and Communal Waste", included a number of highly controversial questions, but dealt with many matters which are the subject of much anxious thought to-day and, above all, merit the attention of scientific workers. The contrast between the immense potential productivity of the world, which is largely the result of the application of scientific method and discoveries, and the immense amount of poverty and unemployment which exists side by side with such productive powers, is essentially a challenge to scientific workers whose labours have been a vital factor in increasing the productive capacity of the world. Among other causes of the present position indicated by Mr. Hodgson are not only the numerous forms of industrial waste, but also those forms of communal waste such as armaments, tariffs, unemployment, inadequate housing, sanitary, medical, and educational facilities, restrictions on transport, and, sometimes, forms of rationalisation which tend to reduce the wealth and services available within a community.

These forms of communal waste are the outcome partly of ignorance and partly of vested interests, and they only persist through the absence of impartial scientific inquiry and analysis on a scale competent and authoritative enough to compel rational action.

Among the factors responsible for the present situation, the concentration of credit power in the hands of socially irresponsible people is regarded as fundamental, and in its reaction on industry has encouraged continued increase of technical efficiency, the reduction of wages and staff, replacement of skilled by unskilled labour, mass-unemployment, the formation of mergers or trusts, the growth of tariffs, leading ultimately to restricted output and sabotage of excess products.

Mr. Hodgson, pointing out the absurdity of production which leads only to waste, suggested that strenuous efficiencies are surplus, and that if communal wastes are eliminated and routine work efficiently organised and shared by all, a comparatively small amount of routine will be required of each individual worker. Our aim should be to organise the production of the goods necessary for the maintenance and



development of the community, or their purchase from outside in exchange for commodities produced at home, by the minimum expenditure of effort. In place of the existing credit system, the creation by the Treasury of notes to the value of goods and services available is suggested. These notes would be issued to individuals as wages or endowment, according to age, grade, or services rendered. No one would receive notes which are insufficient in value for the maintenance of a normal, ample life, and while suitable compulsion would be provided regarding a necessary two months' maintenance work, it would be unnecessary to fix an upper limit of remuneration since additional notes would be issued only for actual services and could not be loaned at interest. Under this system no taxation would be required, as the notes necessary to cover all national services would be withheld from distribution. Endowed leisure would be a prominent feature, and the system would definitely lead towards regional specialisation, the exchange between which would be by means of goods.

### Chromosome Studies and Plant Breeding

THE breeding of plants with the object of obtaining new and improved varieties is at best a slow and laborious process, with chances of success by no means assured. Any means of prediction of the probable results of a cross would be of immense value, and Dr Darlington shows in a series of eight papers<sup>1</sup> how far this object may be attained by a previous knowledge of the cytology of the forms to be crossed.

The author passes to the practical view of the question with the minimum of technical detail, and shows how very closely the behaviour of plants in breeding can be correlated with their visible chromosome behaviour. He gives us the picture of a fertile germ cell as carrying a set of chromosomes, which must represent a complete and balanced set of characters, for in exceptional cases such germ cells are able to develop into a new plant without fertilisation. Normally two sets of chromosomes come together at fertilisation and remain associated throughout vegetative growth until germ cells are formed again. In this latter process, an exact pairing of like chromosomes, which afterwards separate, one of each pair passing to each daughter nucleus, is usually associated with the production of fertile germ cells. Irregularity in this pairing frequently results in the production of unbalanced sets of characters in the germ cells, with loss or great reduction in fertility. This is a fundamental point in cross breeding, where the value of the hybrid depends on seed fertility, as in the case of cereals, cherries, and plums.

On the other hand, crosses between plants with different chromosome numbers, which result in sterile hybrids, may have advantages when the plant is required for ornamental purposes and can be propagated vegetatively.

Another interesting fact which has emerged from comparatively recent cytological work is that related species of plants often have either the same chromosome number or some multiple of a basic number; that is, they are naturally occurring 'polyploids'. Work on plants in cultivation and under cytological observation has brought forward facts which are most suggestive as to a possible way in which species may have been derived from one another. This is illustrated by the cross between *Primula floribunda* and *P. verticillata*, which results in a sterile hybrid. Occasional fertile seeds are, however, produced, and they give rise to plants with hybrid

characters, but differing in being fertile and breeding true. Such seedlings—known as *P. Kewensis*—are found to contain twice the anticipated number of chromosomes, and as each parental set has been doubled in such plants, exact pairing is again possible with the passage of two complete balanced sets to each daughter nucleus. The relative numbers of chromosomes in naturally occurring species suggests that hybridisation followed by restoration of fertility by polyploidy is one possible method of their origin.

These and many other problems are dealt with fully in these papers. Although, as Dr Darlington points out, the knowledge gained by a preliminary chromosome investigation cannot control the results obtained by a cross, it may be of great value in directing the activities of the plant breeder into lines which have some hope of success.

<sup>1</sup> *Gard Chron*, vol 90, Nos 2332-2347, 1931.

### University and Educational Intelligence

CAMBRIDGE—An appointment to a University lectureship in mathematics will be made in the Easter term, to take effect from Oct 1. The initial basic stipend is £200 a year, but an additional allowance of £150 a year may be granted to a lecturer who is not a fellow of a College, and also a number of years' seniority carrying with it an increased basic stipend. Candidates are requested to send their names, with any evidence of qualifications which they may desire to submit, to Mr W J Harrison, Secretary of the Faculty Board of Mathematics, Clare College, Cambridge, on or before April 30.

The examiners consider that the following submitted essays of distinction for the Smith's prizes and Rayleigh prizes: D W Babbage (Magdalene College), "Cremona Transformations"; J Bronowski (Jesus College), "On a Representation of Primals"; J Cossar (Magdalene College), "On Fourier Integrals"; V V Narliker (Non-Collegiate), "Cosmogony and Astronomical Dynamics"; H M Taylor (Clare College), "The Anomalous Scattering of X-Rays". The Smith's prizes are awarded to D W Babbage and H M Taylor, and Rayleigh prizes to J Cossar and V V Narliker.

Dr J A Venn, Gilbey lecturer in agriculture in the University, has been elected president of Queens' College.

LONDON—The degree of D Sc in chemistry has been conferred on Frank Bell (Battersea Polytechnic) for a thesis entitled "Polarisation and Chemical Reactivity in Aromatic Substances" (*J Chem Soc*, 1928-30).

APPLICATIONS are invited for the Henry George Plummer fellowship in pathology of the Imperial College of Science and Technology, for research in morbid anatomy, histological anatomy, chemical pathology, protozoology, bacteriology, or allied subjects in either zoology, medicine, or botany. Applications must be made by letter to the Rector, Imperial College of Science and Technology, Prince Consort Road, S W 7, by at latest June 11.

An election of Beit junior memorial fellows for medical research will take place in July next and applications for them are invited. The annual value of each fellowship is £400 and the tenure usually three years. Forms of application and full information may be obtained by letter addressed to Prof T R Elliott, Honorary Secretary, Beit Memorial Fellowships for Medical Research, University College Hospital Medical School, University Street, W C 1. Completed forms of application should be returned by May 18.

### Calendar of Geographical Exploration

March 21, 1699—Abyssinia via the Nile

A Jesuit, Father de Brèvedent, and a French doctor, Charles Poncet, reached Sennar. They left Cairo in June 1698, went down the Nile to Siout, and then struck across the desert and passed through Dongola to Sennar, reaching the Blue Nile above its confluence with the White Nile. Leaving Sennar, they recrossed the Blue Nile, reached the Gundwa, the headstream of the Atbara, and arrived at the borders of Abyssinia, where de Brèvedent died. Poncet entered Abyssinia, and stayed there until early in 1700, when he returned to Massaua. Poncet's journal gave much information about the regions through which he passed, and especially about their natural history.

March 21, 1871—Henry Morton Stanley

Stanley's remarkable series of African explorations began on this date with his journey from the east coast of Africa to Ujiji, where he met Livingstone and with him explored the northern shores of Tanganyika. His next expedition, 1874-77, from east to west of Central Africa, resulted in the mapping of the course of the Congo River, in a knowledge of the relation of the Kagera to the Nile, in the discovery of Lake Dwera, and in the solution of many other geographical problems of the region. In 1887-90 he discovered the Ruwenzori Mountains, traced the course of the Semliki River, discovered Lake Edward Nyanza and the great south-western gulf of Victoria Nyanza. Much information about the pygmy tribes of the Congo forest was collected. His journeys outlined the main facts of the sources of the Nile, and completed the work of the earlier explorers of the Nile and of Livingstone and Cameron.

March 22, 1830—Mouth of the Niger

Richard and John Lander arrived at Badagry, on the Slave Coast of the Gulf of Guinea. They then made their way inland to Bussa, on the Niger River, the journey occupying three months. After careful preparations, they embarked on the river in two canoes and sailed down it to the Atlantic Ocean, thus at last clearing up the course taken by the Niger River. They also found that the Benue River joined the Niger. Their courage in entrusting themselves in such frail barks on an unknown river and in facing the dangers of tropical diseases, hostile tribes, and uncharted rocks, dangers which had already taken toll of many previous explorers, was rewarded by the solution of a problem upon which Mungo Park and Clapperton had worked. It is interesting to note that a 'stay-at-home' geographer, James M'Queen, had fourteen years previously correctly mapped out the course of the Niger on scientific principles, and had proved that it could only terminate in the Bight of Benin.

March 23, 1843—Middendorf in Siberia

A. T. Middendorf left Turukhansk, went down the frozen Yenisei, and thence over the tundra to the basin of the Khatanga River. He then proceeded northwards to the Taimyr peninsula, and, in spite of many hardships, brought back valuable descriptions of the life of the region. Later he journeyed from Yakutsk to the Sea of Okhotsk, crossing the Stanovoi Mountains and exploring the Amur basin as far as Lake Baikal. Middendorf's accounts of the regions he traversed are of great scientific value, especially for the study of the flora and fauna of Siberia.

March 24, 1921—R. E. Cheesman in Arabia

Major R. E. Cheesman started his exploration of the coast-line of eastern Arabia, near the island of Bahrein, at the Bay of Salwa. The coast between Oqair and Salwa had never been visited by a European, though Burchardt in 1904 passed Salwa on a different route. Cheesman made a route traverse of the coast, accompanied by a sailing boat which carried his chronometer. He was much interested in the ruins of Salwa, which may have been the Phœnician Gerra. In 1923-24 Cheesman explored the desert of Arabia southward from Hofuf, discovering the oasis of Jabrin, previously unvisited. A feature of his work was his record of bird life in the regions which he visited.

### Societies and Academies

#### LONDON

Institute of Metals, March 9—J. Newton Friend. The relative corrodibilities of ferrous and non-ferrous metals and alloys. (3) Final report. The results of three years' exposure at Southampton Docks. The metals examined included lead, zinc, tin, aluminium, copper, nickel, and various alloys containing iron, chromium, nickel, copper, and zinc. Nickel-copper alloys, particularly the 70/28 alloy, offered great resistance to corrosion. High-grade zinc and tin were slightly more attacked than the less pure metals. Tension, riveting, and cold-working did not appreciably affect the corrosion of nickel-chromium alloy steels, but in every case cracks appeared at welds. Alloy steels resisted corrosion well, they are subject to serious localised corrosion.—O. F. Hudson and J. McKeown. The properties of copper in relation to low stresses. The effect of cold-work, heat-treatment, and composition. (1) Tensile and compression tests under short-time loading. The tensile tests have shown that all the materials tested possess a certain limit of proportionality due to the applied cold-work, and that this limit of proportionality can be considerably raised by suitable heat-treatment. There is a superior resistance to deformation brought about by cold-work and suitable heat-treatment, and also a greater resistance to deformation conferred on copper, particularly at elevated temperatures, by the presence of a very small percentage of silver and also by the presence of tin and silicon.—H. J. Tapsell and A. E. Johnson. The properties of copper in relation to low stresses. The effect of cold-work, heat-treatment, and composition. (2) Creep tests at 300° C and 350° C of arsenical copper and silver-arsenical copper. Improvement in resistance to creep at 300° C and 350° C is effected by the special pre-treatment of the alloys, and alloys containing 0.072 per cent silver are superior to the silver-free alloys.—R. Seligman and P. Williams. The interaction of aluminium and water vapour. The statement having been made recently that aluminium and its alloys are rapidly attacked by super-heated steam at 300° C, the authors have made experiments and have found that no such attack takes place under the conditions which they define.—F. Bollenrath. On the influence of temperature on the elastic behaviour of various wrought light metal alloys. The elastic properties increase with decreasing temperature, except in the cases of two aluminium alloys with a high silicon content.—D. Hanson and C. E. Rogers. The thermal conductivity of some non-ferrous alloys. Aluminium-copper alloys were tested, also the effect of aluminium, nickel, iron, phosphorus, and arsenic on the thermal conductivity of copper.—A. J. Sidery, K. G. Lewis, and H. Sutton. Intercrystalline corrosion.

of duralumin. Partial immersion in a *N*-1 solution of sodium chloride to which 1 per cent (by weight) of hydrogen chloride had been added was capable of producing intercrystalline corrosion consistently in samples of duralumin where a propensity towards this type of corrosion existed. Overstrain in tension increased slightly the tendency towards intercrystalline penetration, but no relation was observed between this tendency and the degree of elongation. In general, the higher the quenching temperature the smaller was the tendency of the material to develop intercrystalline corrosion.

## PARIS

Academy of Sciences, Feb. 1 — A. Cotton, G. Dupouy, and M. Scherer. The magnetic rotatory power of blende and the measurement of the fields of electromagnets furnished with perforated pole pieces. Utilisation of magnetic rotations of thin plates of blende for the measurement of intense magnetic fields — Gabriel Bertrand. Can gold be considered as one of the elements of living matter? Berg has stated that gold is present in the brain of the ox in the relatively high proportion of 14 mgm. per kilogram of dry substance. The author has repeated Berg's experiments with negative results. If the ignition is conducted in a platinum vessel a trace of this metal, but no gold, is found after following Berg's process, but after ignition in silica there is no trace of either platinum or gold — E. Mathias. Variation of the surface tension of fulminating material as a function of the temperature and molecular weight — Ch. Porcher and A. Tapernoux. Search for indoxyl (indican) in cow's milk and goat's milk. A criticism of a recent communication by Ch. Hervieux. The thymol reaction for indoxyl derivatives is not trustworthy — Paul Boum was elected *Correspondant* for the Section of Anatomy and Zoology — Th. Anghelutză. A functional equation — Gaston Julia. The reconstruction of a  $\sigma$  Riemann surface corresponding to a multiply connexe area  $\Omega$  — Jean Pierre Robert. Riquier's problem and its generalisations — M. Ghermanesco. Certain systems of linear partial differential equations of the elliptic type — F. Leja. The domain of convergence of series of homogenous polynomials — Edouard Callandreau. The maximum strain in a plane body perforated by a circular hole — Sonier. Thin rectangular plates submitted to variable forces — Michel Luntz. The virtual profiles of least resistance — D. Barbier. The probable periods of visual double stars the orbit of which is still unknown — Bernard Lyot. The study of the solar corona with the spectroheliograph otherwise than during an eclipse. In a previous communication the author has given an account of how he saw and photographed the green and red lines of the solar corona with a direct vision spectroscope. These experiments have been repeated with two spectrographs of much greater dispersion and with a spectroheliograph. The results described prove that by these methods it is possible to study the green and red lines of the coronal spectrum at any time, and in a more complete and exact manner than during eclipses — N. Gunther. The Newtonian potential — A. Schweitzer. The variation of dimensions produced by annealing cold hardened copper — J. Jaffray. Some properties of vacuum thermocouples. Supplementing an earlier communication, the effect of the variation of the external temperature has been studied and a method of correction worked out — André Chevallier and Pierre Dubouloz. Intensity measurements in the ultra-violet spectrum by means of photoelectric cells sensitised by sodium salicylate. In an earlier communication the authors have described the application of a potassium photo-

electric cell, sensitised by sodium salicylate, to the study of the ultra-violet. It is now shown that the curves obtained giving the intensity of the fluorescent light as a function of the wave-length agree closely with those obtained by other methods — Mlle Suzanne Veil. The action of the electric field on gelatine. The effect of the presence of an indicator. Deformations undergone by gelatine in an electric field correspond with physico-chemical changes in the medium — P. Jacquet. Study of the tensions in electrolytic copper deposited in the presence of gelatine — René Pallu. Study of the system  $H_3PO_4$ ,  $Ca(OH)_2$ ,  $CO_2$ ,  $H_2O$  — T. Karantassis. The action of hydrocyanic acid on the halides of the tervalent and tetravalent metals. The existence of the compounds  $TiCl_4 \cdot 2HCN$  and  $AlCl_3 \cdot 2HCN$  is proved — A. Maille and Renaudie. The transformation of ketones into liquid hydrocarbons. Using silica gel as catalyst, ketones (acetone, propione) gave a mixture of aromatic and unsaturated hydrocarbons with a small proportion of naphthalene and anthracene — A. Wahl and R. Lantz. The preparation of some new derivatives of  $\beta$ -naphthol — F. Salmon-Legagneur.  $\beta$ -Homocamphoric acid. A new mode of formation of  $\beta$ -camphor — Émile André and Charles Vernier. The *d*-cinoleates of  $\alpha$ -phenylethylamine and *l*-ephedrin — Dalloni. The Silurian grits and intrusive alkaline rocks of the older formations of Tibesti — André Demay. The fragments of Hercynian overlapping near Vivarais — Chadeaud. The chondriosome of the green algae — Mlle Lucienne George. Observations on *Sorbus torminalis* — Aug. Chevalier. The places deprived of vegetation in the Sahara and their cause from the point of view of plant ecology — Friant. The influence of the size of the body on the dental morphology of mammals — Jules Amar. The hydrothermal coefficient in homeotherms — René Hazard. The action of sparteine on the inversion by yohimbine of the vasoconstrictor effects of adrenaline — A. Auguet and J. Lefèvre. Curves of loss and of metabolism as a function of the external temperature in the homeotherm in repose — A. Policard and A. Morel. The utilisation of the spectrography of lines in histochemistry (histospectrography). A modification of the method proposed by W. and W. Gerlach for which some advantages are claimed — R. Pussard. A parasitic nematode of *Psylla* — Ph. Lasseur, A. Dupaux, and M. Grojean. Factors of stability of bacterial suspensions heated to 80° C. The remarkable stability of bacterial suspensions after heating to 80° C., is explained, at least in part, by a decrease in the surface tension of the dispersed medium, an increase of the electric charge, and an increase in the viscosity — Pilon and Codvelle. The action of metallic copper on the germs in drinking water.

## LENINGRAD

Academy of Sciences — *Comptes rendus*, No. 10, 1931. — A. P. Vinogradov. Colorimetric determination of vanadium by the method of phospho-tungstic acid. The method, which is described in detail, is particularly suitable for the determination of vanadium in living organisms — V. P. Rusakov. Radioactivity of phosphorites and their extracts. The average radioactivity of phosphorites exceeds considerably that of more common soils and rocks. The radioactivity of water extracts from phosphorites is very weak, of the order  $10^{-12}$  per cent of radium. The radioactivity of extracts made by 10 per cent solution of hydrochloric acid is, on the average, of the order  $10^{-10}$  per cent of radium — V. Milchevskaja-Rutkovskaja. Rubidium (and caesium) in microclines from different localities — E. Krinov. The meteorite of Staroje Borisino. Description of a meteorite which fell on April 20, 1930,

65 km north of Buguruslan —C Flerov Data on the craniology of the family Equidae Craniological characters of the recent members of the family are tabulated and discussed The conclusion is reached that they all form one genus, *Equus*, with three subgenera, namely, *Equus*, including the domestic horse and *E. przewalski*, *Asinus*, comprising Asiatic and African wild and domestic asses, and *Hippotigris*, which includes zebras and quaggas —B Galerkin The flexion of thick elastic plates, rectangular and triangular, poised on their contours A contribution to a solution of the problem of theory of elasticity in the case of three dimensions, with the aid of functions of tension and displacement

## Forthcoming Events

### FRIDAY, MARCH 18

ROYAL SOCIETY FOR THE PROTECTION OF BIRDS (Annual Meeting) (at the Middlesex Guildhall, Westminster), at 3 —Chairman Earl Buxton Speakers Viscount Grey of Fallodon and J H Whitehouse

GLASGOW CHEMICAL SOCIETY (Annual General Meeting) (at Glasgow University), at 4 —Prof G G Henderson Publication of Chemical Literature (Presidential Address)

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5 —Annual General Meeting, followed by an Ordinary Meeting —A S Rao The First Spark Spectrum of Arsenic (As II) —J S Rogers The Photographic Measurement of the Absorption Coefficients of Gamma-rays from Radium (B+C) —M Fahmy On the Derivation of Maxwell's Equations from the Equations of the Quantum Theory

UNIVERSITY COLLEGE, at 5 30 —Prof A J Toynbee The Turks (Lecture)

IRON AND STEEL INSTITUTE (Annual General Meeting) (at Royal Technical College, Glasgow), at 7 15 —W E J Lewis Notes on Autogenous Welding

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Thomas' Café, Swansea), at 7 30 —Annual Meeting

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Lord Rutherford of Nelson Recent Researches on the Gamma Rays

### SATURDAY, MARCH 19

BRITISH MYCOLOGICAL SOCIETY (London Meeting) (in Botanical Department, University College), at 11 A M

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3 —F C Boon Teaching the Method of Ratio (Lecture)

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Lord Rutherford of Nelson Discovery and Properties of the Electron (4)

### MONDAY, MARCH 21

KING'S COLLEGE, LONDON, at 5 30 —Prof Juhan Huxley Impressions of Soviet Russia (Lecture)

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre and West Wales (Swansea) Sub-Section) (at Swansea), at 6 —Prof J K Catterson-Smith Everyday Uses of Electricity (Faraday Lecture)

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section—London), at 6 45 —Annual Meeting

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (Annual General Meeting) (at Hotel Metropole, Leeds), at 7 15, followed by an Ordinary Meeting, at 7 45 —Dr C J Smithells Photoelectric Cells and their Industrial Applications

ROYAL SOCIETY OF ARTS, at 8 —A E L Chorlton Oil Engine Traction (Howard Lectures) (3)

### TUESDAY, MARCH 22

ROYAL SOCIETY OF ARTS, at 4 30 —Dominions and Colonies Meeting

ROYAL PHOTOGRAPHIC SOCIETY (Scientific and Technical Group) (Annual General Meeting), at 7 —E E Jelley

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A Cause of Yellowness in Sepia Toning —S D Threadgold The Measure of Graminess

### THURSDAY, MARCH 24

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (Annual Meeting) (at Institution of Engineers and Shipbuilders, Glasgow), at 7, followed by an Ordinary Meeting, at 7 30 —Dr C L Whittles The Chemist, the Soil, and the Farmer

## Official Publications Received

### BRITISH

Proceedings of the Royal Society of Edinburgh, Session 1931-1932 Vol 52, Part 1, No 3 Calendar of Hume MSS in the possession of the Royal Society of Edinburgh By J Y T Greg and Harold Beynon Pp 138 11s 6d Vol 52, Part 2, No 4 The Effect of Malnutrition on Root Structure By Dr George Bond Pp 159 17s +2 plates 1s 9d Vol 52, Part 2, No 5 On the Orthogonal Polynomials in Frequencies of Type B By Dr A C Aitken Pp 174 182 9d (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd)

Annals of the Natal Museum Edited by Dr Ernest Wærren Vol 7, Part 1, February Pp 144+6 plates (London Adlard and Son, Ltd) 15s net

Department of Scientific and Industrial Research Building Science Abstracts Vol 5 (New Series), No 1, January Abstracts Nos 1188 Pp 86 (London H M Stationery Office) 1s net

Department of Scientific and Industrial Research Report of the Forest Products Research Board, with the Report of the Director of Forest Products Research for the Year 1930 Pp vii+52+10 plates (London H M Stationery Office) 4s net

Proceedings of the Royal Irish Academy Vol 40, Section A, No 5 Electric Discharge from Water Drops By J J Nolan and J G O'Keefe Pp 86 98 6d Vol 40, Section B, No 12 A Tectonic Analysis of the Mourne Granite Mass, County Down By Dr Herbert P T Rohleder Pp 160 174 6d (Dublin Hodges, Figgis and Co, London Williams and Norgate, Ltd)

Journal of the Society of Glass Technology Edited by Prof W E S Turner Vol 15, No 60, December Pp 53-101+259 372+353 587+xxvi (Sheffield) 10s 6d

Reports of the Progress of Applied Chemistry Vol 16, 1931 Pp 748 (London Society of Chemical Industry) To members, 7s 6d, to others, 12s 6d

Oilsgoil Na h-Eireann (The National University of Ireland) Calendar for the Year 1931 Pp viii+306+532+238 (Dublin)

### FOREIGN

U S Department of the Interior Geological Survey Bulletin 834 Bibliography of North American Geology, 1929 and 1930 By John M Nickles Pp ii+280 45 cents Water Supply Paper 675 Surface Water Supply of Hawaii, July 1, 1927, to June 30, 1928 Pp v+105 20 cents (Washington, D C Government Printing Office)

Scientific Papers of the Institute of Physical and Chemical Research No 346 Hyperfine Structure of Mercury, III By Kiyoshi Murakawa Pp 299 306 20 sen No 347 Chemische Untersuchungen in der Saponinreihe Mitteilung 1 Über das Glucosid von Panax Ginseng C A Mey Von Munio Kotake Pp 4 10 sen No 348 Chemische Untersuchungen in der Saponinreihe Mitteilung 2 Über die Saponine von Kalopanax ricinifolius Von Munio Kotake und Katsuta Taguchi Pp 5-11 15 sen No 349 Carotin und Dihydroergosterol in Green Tea By Michio Tsujimura Pp 13 21 15 sen Nos 350 354 On the Enzymes of Chicken Sarcoma, by Eichi Somekawa, Über den Spinnometer und seine Anwendung, I, von Sin-itarō Iwasaki, Über den Spinnometer und seine Anwendung, II, von Sin-itarō Iwasaki Syntheses of Chalkone Homologues and related Compounds, Part 1 Methoxy Acetophenone, Methoxy Chalkone and some related Compounds, by Miss Chika Kuroda and Miss Tokiko Matsukura, Syntheses of Chalkone Homologues and related Compounds, Part 2 Some Homologues of Methoxy Chalkone and their related Compounds, by Miss Chika Kuroda and Miss Teruko Nakamura Pp 23 76 60 sen (Tōkyō Iwanami Shoten)

Carnegie Institution of Washington Year Book No 30, July 1, 1930, to June 30, 1931, with Administrative Reports through December 11, 1931 Pp xix+63+505 (Washington, D C)

Cornell University Agricultural Experiment Station Bulletin 526 Potato Storage on 259 Farms in New York By A L Wilson and E V Hardenburg Pp 58 Bulletin 527 The Supply Side of the New York Milk Market By H A Ross Pp 151 Bulletin 528 Fermentation and Crystallization of Honey By Elton J Dyce Pp 76 Bulletin 531 Relative Effectiveness of Limestone Particles of Different Sizes By T L Lyon Pp 13 (Ithaca, N Y)

### CATALOGUES

Oxford University Press General Catalogue, 1931 Pp 408 (London Oxford University Press)

Catalogue of Scientific Books and Publications of Learned Societies (No 386) Pp 102 (Cambridge W Heffer and Sons, Ltd)

A Catalogue of Book Bargains (No 534) Pp 16 (London William Glashier, Ltd)

Medical Books, including Surgery, Dentistry, Pharmacy, Sexology, Nursing, Hygiene, Anatomy, Pathology, Ophthalmology Pp 62 (London W and G Foyle, Ltd)

The Microid Physical Series New Designs in Physical Apparatus, with Experimental Notes (Catalogue No 115X) Pp 40 Microid Balances and Weights (List No GT1031) Pp 4 (London Griffin and Tallock, Ltd)



SATURDAY, MARCH 26, 1932

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No 3256, Vol 129]

## Biology in the Schools

APART altogether from the importance of biology as a vocational study—biology for bread—upon which the Chelmsford Report laid emphasis (*NATURE*, Feb 20, p 257), there is the wider and more humane aspect of biology as an appreciation of the unity of living things, and therefore as the link between the individual and all his environment—biology for life

Why is it that the value of this appreciation, as something that adds interest to life and has a social value as well as an intellectual, has not been sufficient to compel the inclusion of biology in the work of the schoolroom? Of its definite exclusion from the school there can be no doubt, in spite of the exceptions which emphasise the rule. Nothing could be more encouraging to the enthusiastic biologist than, say, last year's annual reports of the work done by the natural history societies at Eton, Marlborough, and a few other schools, they show a grasp of the possibilities of Nature study, an appreciation of the zest of discovering new things, and, above all, an intense keenness in this branch of study which combines learning with investigation. But these are shining lights, the vast majority of the children of Great Britain walk in biological darkness to them the opportunity of this ever-fresh interest is denied. Of eighty-six medical students going to one of our northern universities this winter for the first time, six had learned a little botany, the others had neither botany, zoology, nor biology—a measure of the lack of biological teaching in the schools of the north, and probably the condition is repeated, though, we trust, not so decisively, in other regions of the kingdom.

One of the deciding factors in the area we refer to is the exclusion of biology and related sciences from the subjects for proficiency in which competition bursaries are awarded. The bursary competition enforces a trend of curriculum in the schools as inevitably as the scholarship examinations and awards at Oxford and Cambridge have been found by the Chelmsford Committee to enforce over-specialisation within a limited range of subjects.

A second deciding factor against biology as a school subject has been the well-entrenched position of physics and chemistry in the curriculum as representative of the observational sciences. With this may be associated the fact that it is probably easier to devise a suitable observational and experimental course with inanimate material than

with living organisms, and consequently that the proper teaching of biology is more difficult and the supply of adequately trained teachers much more restricted

These factors lie outside the direct influence of the biologist, but the third factor which has hindered the adoption of biology in the schools lies with the biologists themselves—they have failed to give a decided lead as to what biology in the schools is to connote. It is regarded as a vague term, covering a multitude of ill-defined interests, or it is looked upon as simply a little botany plus a little zoology, each almost or altogether isolated in its own compartment. Within the last year or two, many books devised for the teaching of biology in schools have been published, and their variety in range, in subject matter, and in treatment shows how earnest an endeavour is being made to meet the demand for guidance, but at the same time it exposes the difficulty with which the willing but less experienced teacher is faced when he has to choose between so many possibilities.

We would be the last to suggest that a formal and set course in biology should be imposed upon such schools as desire the subject, for it is one of the attractive features of biology that it can and should adapt itself to the special environment of each locality. But we do say that now is the time for indicating the content of biology as best fitted for the interests of pupils in schools, and of giving a skeleton form to a subject which to many appears to be so vague as to be almost formless. Otherwise, how can it be expected that school managers or governors, unacquainted with the subject at first hand, will be able honestly to decide that here is a branch of science eminently suited and highly desirable for inclusion in the curricula of the schools under their care?

In the devising of such a course, which is to influence and appeal to a vast majority of pupils who will never enter a university or apply biology professionally, the constant aim must be biology for its interest, its outlook, and its understanding—'biology for life'.

The problem of the biology course is not confined to Great Britain. For twenty years and more the subject has been taught in the high schools of the United States of America, and so long ago as 1905 the State of New York issued its first syllabus in biology. The result was definite and encouraging, for work in the new field developed rapidly and met with unusual success. It was accompanied by an increasing desire to keep the science

teaching in the schools in touch with the experience of the pupil in his own environment, and there followed the State's syllabus in general science in 1925. On this a broad foundation of scientific knowledge has been laid, and it is testimony to skilful planning that in its turn the growing emphasis upon the work in general science has demanded a further step in evolution, and that is the development of a broad course in general biology to cap the training in general science.

This new course, the substance of which has just been published,\* is the result of a year and a half of consideration by a committee of science teachers and educationists selected for the purpose. It aims at rounding off the science training of the schools by bringing within the range of the many adolescents in the secondary schools the larger conceptions of biology, therefore it presupposes the existence of an earlier training of one to three years in general science. It is worth while considering the nature of this foundational training, for upon its soundness the fate of the edifice must rest.

There is universal agreement, the committee states, that the preparatory general science should deal with the environment, and should centre about the pupil as the interested focus of his or her environment. "General science should not consist of a succession of physical, chemical, biological, astronomical, and similar topics presented chiefly as a survey of these different sciences. The purpose of general science is not to acquaint the pupil with the various sciences as entities in themselves," but to lead him "to investigate as an individual the various phases of the environment as they impose themselves upon him."

That seems to be a simple limitation, but it is far from being so simple as it looks, and accordingly it has been found that the teacher, perhaps following his own bent rather than the child's, perhaps because it is easier, has often strayed much further into, say, the "practical and mechanical application of physical principles and into the abstract underlying laws than is justified by the attitude of enquiry on the part of the pupil." Nevertheless, the rule is that general science in its early stages should deal with immediate environment, and that every lesson should start off from the outlook of the pupil, with all its limitations and immaturities—that is sound teaching, which should lead the pupil gently into varied fields of chemistry, physics, and simple biology.

\* Tentative Syllabus in General Biology, published by the University of the State of New York, Albany, 1931. Pp. 62.



On ground thus prepared, the course of general biology is to be laid. It opens and it closes with man in the centre of the picture, played upon by, and in turn playing upon, his environment. The reason for the prominence given to human relations is that studies organised with their focus upon humanity will prove to be psychologically most interesting to the pupils. We do not feel convinced that the insistence at this stage upon the dominance of human contacts is essential, since the interest of the majority of pupils at the age contemplated is easily held by the study of any living thing. But few will cavil at the guiding principles of interest and largest social value which have determined the actual selection and arrangement of the content of the course, or at the endeavour of the committee to arrange the material in a sequence of "dependent continuity and ascending difficulty."

The programme for the course of general biology falls into four sections, divided into two parts—apparently for the convenience of the teaching year, for there is no real discontinuity between the two. The first section deals with "man's place in the world of living things", and the breadth of the treatment is indicated, but only roughly, by the three themes (each to occupy about three weeks of school time) round about which the lessons are grouped—"Man is one species among millions of diverse species", "There is unity among all living things", "Living things and their environment are constantly changing". From simple observation, comparison, and identification of types of plants and animals, and the recognition of diversity of form, the pupil is led to inquire into the significance of similarities and differences, and having associated changes in environment with changes in organisms, he is drawn by inductive methods to the acceptance of evolution as the simplest explanation of these phenomena.

"Self-preservation among living things" is the general subject of the second section, with three supporting themes—"All living things have the same problems", "Living things bear different nutritional relations to their environment", and "Living things have to relate themselves to their environment". The section begins with a study of the activities of single-celled organisms, and of the specialisation which these activities and their associated structures undergo in multi-cellular organisms, nutritional activities are selected for special discussion, and this leads to consideration of the contacts with environment made by the organism through sensation and response.

The topic of self-preservation is followed, in section three, by that of "Race-preservation among living things", and this gives opportunity for a comparative study of reproductive methods, leading to consideration of the cell-basis of reproduction and so to the cell in heredity, to the outlines of plant and animal breeding, and of inheritance in mankind.

In the final section, entitled "Man's increasing control over his environment and over himself", a wide range of possibilities lies before the teacher, for there must be considered typical ways in which environment is 'improved', say, by cultivation and by warfare against other organisms which are inimical to human welfare, and so to the balance of Nature and its unstable equilibrium. Last of all is traced the progress of man as a biological phenomenon, with a unique and accumulating social heritage, and a slow development from the eolith-maker to the time when the domestication of animals hastened the pace towards the scientific age, at the beginning of which we stand to-day.

In the consideration of this ambitious scheme of biological teaching for the secondary school, several important facts must be borne in mind. In the first place, the syllabus, which in the above summary must appear to be despairingly vague to the teacher who longs for a prescribed course of details, has been deliberately denuded of factual content, so that the teacher himself, keeping in view the emphasis upon great biological truths, may adapt the lessons to the particular needs of the urban or rural district in which he is placed. Many hints as to possible modes of treatment are given in the 62 pages of the "Syllabus". In the second place, the syllabus does not stand by itself, but is correlated with an earlier body of general scientific knowledge, and the general biology course is to be succeeded by detailed work in the sciences of chemistry and physics. In the third place, the syllabus is regarded as suggestive rather than final, and it is accompanied by a request to teachers for constructive criticism.

Even before the syllabus meets the test of actual trial, however, it will be recognised that the Committee has done a useful work in emphasising the close relationship between biology and the social sciences, and in making a determined step towards the creation of a co-ordinated programme of science tuition which will endow pupils about to leave the upper schools with the broadest values likely to be obtained by the application of the scientific method.

J R

### Can Nature be Explained?

*Mind and Matter.* The first of two volumes based on the Gifford Lectures delivered in the University of Edinburgh in 1919 and 1921. By Prof G F Stout. Pp xiv + 326 (Cambridge At the University Press, 1931) 12s 6d net

PROF STOUT writes in a rather antiquated philosophical dialect which makes it difficult in many places for a reviewer by about half a century his junior to be sure exactly what he means, and still more difficult to separate his main argument from incidentals. So far as I understand it, Prof Stout's book is an attempt to provide a theory of the relation between perceiving minds and physical objects which shall not violate common sense, as he considers, and I think rightly, that it is violated by two of the most notable types of theory, both by what Prof Moore has called the *Mill-Russell Type*, which minimises or eliminates unperceived physical events, and by the Cartesian type of theory, according to which percepts are only representations or reflections of physical events.

The Mill-Russell type of theory regards physical objects as sets of actual and possible sense-data, to say that a possible sense-datum exists simply means that had there been an observer at a certain place and time, where and when in fact there was none, he would have observed a certain kind of sense-datum. But according to common sense this sort of hypothetical proposition is true, and can only be true because there is a physical object which the supposed observer would have perceived, and which existed although at the time in question no one perceived it. According to the Cartesian type of theory, sense-data are events which represent and are caused by physical objects, but are not parts or aspects of them, and it is with sense-data alone, and not with physical objects, that we are acquainted, as this phrase was used by Lord Russell in "The Problems of Philosophy". But the view of common sense is undoubtedly that when we perceive physical objects we are in some sort of sense in contact with them, and not merely in contact with some medium between them and ourselves.

Prof Stout begins the construction of a more congenial theory by an account of what he calls *the animism of common sense*. It appears to him, as it has to other philosophers, that our understanding of physical processes is increased by the organic sensations which inform us about our own bodies. There are at least two distinct ways in which this suggestion can be applied. If, for example, I support a heavy object in my hand, I

have an experience which may be called a feeling of weight or pressure, it may then be said that the object of my feeling is characterised by a certain quality which I shall call strain. Now, if I watch a parcel being weighed on a spring balance, as the spring is compressed it is possible that it is characterised by a quality similar to this quality of strain—of course without the accompaniment of anything comparable to my experiencing of the strain. I do not see conclusive reasons for rejecting this form of animistic explanation. But on the other hand it may be thought, as Leibniz appears to have thought, that while we understand how our own actions take place, because our knowledge of them comes as it were from the inside, we cannot understand how any action takes place which is not that of a living organism. Thus we can only understand what happens when the parcel rests on the balance if we suppose that as the parcel descends the spring spontaneously contracts to make way for it, like a dog shrinking before a blow.

Now, so far as I can see, though Prof Stout does not actually assert that this sort of view of Nature is true, he does ascribe it to common sense, as the champion of which he appears. But I think it is clear that common sense, on the contrary, makes a very definite distinction between mechanical and vital occurrences, and would consider that when, for example, the dog shrinks from his master's raised hand, he is in some sense behaving vitally in order that he shall not be subject to a certain kind of mechanical occurrence. I think it is clear also, quite apart from the question whether we do in any proper sense understand our own actions better than we understand mechanical events, that the alleged fact that we can only understand these mechanical events by interpreting them animistically is no ground for thinking the animistic interpretation true.

After a long consideration of previous psychophysical theories, Prof Stout goes on to state his own view of perception. His fundamental contention is that "physical existence which is immediately known is never actually experienced as sensations and feelings are", "we know immediately and not by inference the actual existence of what is not actually experienced", and he develops this by saying that "when I try to fix attention on a sensum or feeling as such. I can only distinguish it within a context [which] always includes real existences which are not being actually experienced". From the passage which I have quoted last, it appears as though the things which Prof. Stout refers to as immediately known though not

experienced are such things as peripheral sight-data which are not being attended to. But whether or not he refers to events of that sort, he certainly does refer to physical objects. He asserts then that physical objects are not actually experienced, I think it is quite clear that this means that physical objects are not sense-data or constructions from sense-data, and he asserts that they are nevertheless in some sense or other immediately known. Obviously this cannot mean that we know them by acquaintance, as that phrase is defined in "The Problems of Philosophy", for if we did it would follow that we experience them. Prof Stout elucidates his use of the phrase *immediately known* by analogy with memory. In his meaning of the phrase, when I remember my last visit to the dentist I immediately know that visit, although I am not experiencing it. Now it is clear that when this memory is before my mind I know and am aware of the fact that I did visit the dentist at a certain time, and this may be what Prof Stout would understand by the statement that I immediately know the visit. If so, to say that I immediately know a physical object presumably means that I know and am aware of the fact that a certain physical object is in a certain place. It may well be true that I sometimes know and am aware of facts like this, even if physical objects are not composed of or constructed from sense-data. But is it a novel truth?

Prof Stout's final account of the relations between physical objects and sense-data is that "the sensory continua of individuals are parts of a world-continuum having no independent being of their own apart from it." The causes of changes in my sense-field are "changes within the world-continuum." This appears to mean either that the world consists of individual minds and their sense-fields, or that it consists of these and of sensibilia which do not occur in anyone's sense-field, yet I do not think that Prof Stout would accept either of these alternatives. A psycho-physical theory based on the former alternative would have to be a sort of monadism, such that the *changes in the world-continuum* which determine changes among my sense-data would be changes in other monads. The latter alternative is a form of the Mill-Russell theory. But Prof Stout has explicitly rejected monadism just as much as the Mill-Russell theory on the ground of repugnance to common sense, and I therefore do not see how his final solution is to be reconciled with the common sense he has set out to defend.

AUSTIN DUNCAN-JONES

## Colour Standardisation

*Colour Science · a Handbook for Advanced Students in Schools, Colleges and the various Arts, Crafts and Industries depending on the use of Colour*  
By Dr Wilhelm Ostwald Part I *Colour Theory and Colour Standardisation* Authorised translation, with an Introduction and Notes, by J Scott Taylor Pp xviii + 141 + 13 plates (London Winsor and Newton, Ltd, 1931) 15s

EXCEPT for a historical résumé of the contributions of Newton, Goethe, Schopenhauer, Helmholtz, Young, Maxwell, and Hering, and short descriptions of the tentative efforts at colour arrangement made by other investigators of the eighteenth and nineteenth centuries, this book is purely an exposition of the author's own views on the subject of colour standardisation, and an introduction to his own system. The student of such matters who approaches them through the medium of this book will unquestionably conclude that no one, excepting Ostwald, has paid any attention to them since the days of these early pioneers, and that it is only with the advent of Ostwald's system that colour measurement has become *possible*. This is explicitly stated (pp xiii, 32, and 69), and is implied throughout the whole book.

There are no references to the intensive study which has been devoted to such problems in the United States, Great Britain, and the author's own country within the last twenty years, and no indication is given of the principles which form the common basis of the systems officially adopted at such institutions as the U.S. Bureau of Standards, the National Physical Laboratory, and the Physikalische Technische Reichsanstalt, and employed, with or without superficial variations in minor details, by numerous technical workers in the United States, Great Britain, Germany, and other countries.

It will be evident, therefore, that this book, while it will doubtless be read with interest by those who are already familiar with colorimetric developments but may have found difficulty in following Ostwald's work in German, will give a misleading impression to any beginners who may be induced to regard it as a textbook on colorimetric science.

Prof Ostwald's method of presentation is not likely to appeal to the scientific reader. His style is that of a schoolmaster giving an account of matters concerning which there can be no dispute, it is dogmatic, and therefore unsuitable, where, as in the present case, he is discussing matters on which he is at variance with contemporary workers in the same field. Nowhere is any

experimental evidence offered with sufficient technical detail to enable the reader to appraise its value or check it in his own laboratory. We have to be content with the statement that so and so "withstands this test perfectly" (p. 80), or that "I have found the expected agreement" (p. 138).

Only a brief reference to the main features of Ostwald's theory of colour standardisation is here possible. One fundamental fallacy underlies the whole theory and is responsible for all the special features which distinguish his system. Ostwald claims to have discarded the physical characteristics of the *stimulus*, such as frequency, energy, and luminosity, and to have substituted for these, as the basis of his system of numerical colour specification, the properties of visual *sensations*, including their æsthetic relations, harmonies, etc. In doing so he overlooks the essential nature of every process of *measurement*, and the mathetic impossibility of obtaining by any such process quantitative relations between non-physical things, or between physical things on one hand and non-physical things on the other.

It is now well recognised by every physicist who has given attention to visual problems that every 'colour equation' or 'brightness equation', in whatever nomenclature it is disguised, is a *stimulus* relation. All the experimentally determinable quantities which appear in it are stimulus quantities and cannot be anything else. Ostwald takes as his fundamental relation for the colours of all objects under the same intensity of incident illumination the equation

$$C + W + B = 1,$$

where  $C$  is what he terms the 'full colour' which determines the hue,  $W$  is white, and  $B$  is black. He conceives this to be an analysis of the colour *sensation*. But, whenever we insert *measured* quantities for  $C$  and  $W$ , the equation necessarily becomes an analysis of the *stimulus*. The term in  $B$  then becomes meaningless, since black has no stimulus value and  $(C + W)/1$  is simply the fraction of the incident light which is reflected (or transmitted) by the object. It is equivalent, if the units are properly chosen, to what in present English nomenclature is termed the 'brightness factor' of the specimen. It is a mere photometric ratio of two stimulus intensities. The ratio  $C/(C + W)$  is also a stimulus ratio, and is of the same nature as the ratio which is variously termed, in English literature, 'purity' or 'colorimetric saturation'. The principle is not affected by the fact that instead of employing the easily definable and easily reproducible homogeneous spectral radiations as the hueful

constituents of the system, Ostwald employs the ill-defined and incompletely saturated 'full colours' of his colour circle. If these so-called 'full colours' were properly and unambiguously defined in stimulus terms, an Ostwald specification would be immediately convertible to a specification in terms of dominant wave-length, colorimetric saturation, and brightness factor.

In principle, therefore, the system of colorimetrics embodied in Ostwald's fundamental equation is not new. It follows at once from the application of Newton's law of colour (stimulus) mixture to the Maxwell triangle, and was propounded by Helmholtz in a proposition quoted on p. 22 of the present book, and condemned by Ostwald as having been "the cause of protracted delay in the development of colour science".

The apparent differences of Ostwald's system from previous systems embodying the same principle are all non-essential. The psychological and æsthetic considerations which lead him to base his numerical scales on geometric progressions and give rise to the distinctive features of his nomenclature have no relevance to colour *measurement*, in which stimulus quantities alone can enter. They merely result in confusion of thought and in the absence of proper definition which necessarily results from the apparent determination to avoid calling a spade a spade.

It does not follow, however, that because Ostwald's system of colour specification is merely a disguised form of a well-known and long-established system, which, incidentally, follows directly from the more fundamental 'trichromatic' system, that the practical results obtained by users of Ostwald's methods are sound. It is true that if apparatus were devised to obtain, correctly, the various elements of the Ostwald specification, a perfectly sound and self-consistent system, directly relatable to colorimetric fundamentals, would result, although, in practice, the introduction of the so-called full colours instead of simple homogeneous constituents merely leads to inconvenience. The methods of measurement actually employed by Ostwald are not described in volume 1, and so do not properly come within the scope of this review, but in view of the fact that some of the theoretical conclusions advanced in the present volume are presumably based on such measurements, it is necessary to point out that Ostwald's metrical technique, in which the quantities  $C$  and  $W$  are evaluated by methods of filter photometry, does not in fact give these quantities, but merely an approximation thereto, of more or less crudity de-

pending on the nature of the absorption curve of the specimen under test. This failure of the experimental technique to give a true representation of the fundamental equation is no doubt the cause of these inconsistencies which have been found by those who have carried out proper colorimetric analysis of the Ostwald standards

J GUILD

### Amalie Dietrich, Naturalist

*The Hard Road the Life Story of Amalie Dietrich, Naturalist, 1821-1891* By her daughter, Charitas Bischoff. Pp 317 (London Martin Hopkinson, Ltd, 1931) 10s 6d net

THIS is an intensely human document, not a book of natural history. Amalie Dietrich was the daughter of a leather worker, of Siebenlehn, in Saxony. She was almost uneducated when she married a 'naturalist', an affair of temporary passion on his part. She became his slave, educating herself, learning to collect and mount plants and animals, carting his vasculum and baskets. He lived in the clouds, mostly of his own concert, happy over a new plant which perchance would be called after him. Excursions were made all summer, and in the winter they took the road, visiting town after town, finding out from chemists the addresses of naturalists who might buy their collections. Later Amalie writes "I used to trail all over the country with dear faithful Hector [the dog]! The cart was so heavy and the road often so bad, we had to endure hunger, frost and heat, and ceaseless crushing anxiety as to our daily bread, and you [her daughter]" It is a vivid picture of the collecting craze and of the rivalry that arose out of the work of Linnæus, especially keen in the various State centres of Germany.

This life could not last, and the errant fancy of Wilhelm, her husband, took flight. We need not follow the next years, after which, her reputation as a collector established, she took service under Cæsar Godeffroy. The romance of the Godeffroy Museum, now the property of the City of Hamburg, is well known. Every skipper of this merchant prince was ordered to bring back curiosities from the domains of this "king of the South Seas", whose influence permeated every island group in the Pacific where coconuts were grown, and every beachcomber looked forward to the arrival of his ships. Indeed, in the 'nineties, the writer had more inquiries about Godeffroy than the almost legendary Queen Victoria, his supposed rival. He financed Amalie Dietrich for ten years during which she collected the Queensland region from Brisbane

to Torres Straits and also Tonga. Plants were her speciality, but insects, mammals, birds, native weapons, skulls, and indeed everything, were sent home properly labelled. She loved the collecting and the hard work, the handling and labelling of her specimens, perhaps to-day the most valuable collections secured by any single person.

On her return home, Godeffroy, with characteristic generosity, for thirteen years gave her rooms in his house, close to the beloved museum, and after his death the municipality of Hamburg looked after her. She was still a peasant at heart and in her ways, but she was a genius in her line, and Germany has perhaps a better way of appreciating and making happy such originals as she was. He who sets out to collect can learn much from her story, collecting is not the mere accumulation of specimens, but an art.

J S G

### Short Reviews

*Contraception (Birth Control) its Theory, History, and Practice, a Manual for the Medical and Legal Professions* By Dr Marie Carmichael Stopes. New and enlarged edition. Pp xxvii + 487 + 10 plates (London G P Putnam's Sons, 1931) 15s net

IN this new edition of Dr Marie Stopes's treatise on the control of conception it has been possible to exclude a considerable amount of matter of the nature of 'propaganda' which appeared in earlier editions, and to extend those portions dealing with methods and technique, and so to render the book of more service to the medical practitioner. Needless to say, the book deals very fully with all aspects of the subject, and nothing essential seems to have been omitted. It is of interest to find that the records of birth-control clinics so far available establish the fact that the simplest and cheapest technique of all (a rubber cap associated with a chemical spermicide) yields the highest degree of security and reliability.

Dr Stopes naturally deals at length with arguments advanced against the use of birth-control, but we fear she is as one crying in the wilderness, for there will always be persons or bodies who will oppose it on medical or moral grounds. We believe that the argument of opponents respecting the physical harmfulness to the woman of contraceptive measures has been much exaggerated, and that simple measures like those advocated may be pursued without detriment. As regards abstinence versus contraception for the limitation of families, it may be said that in general for a normal couple living together in the intimacy of married life abstinence appears to have a very deleterious effect. The subject has, however, a much wider issue than that of the individual, for many regard the artificial limitation of populations as a measure upon which the salvation of the human race in the future may largely depend. A fuller and wider knowledge of

contraception and all that it may mean for the individual and the race is desirable among medical men that it may be judiciously passed on by them to the general public, and this new edition of Dr Marie Stopes's book will be found to give all the information that may be required

*Board of Education Science Museum Henson and Stringfellow, their Work in Aeronautics the History of a Stage in the Development of Mechanical Flight, 1840-1868* By M J B Davy Pp 115 + 25 plates (London H M Stationery Office, 1931) 5s net

THE experiments of Henson and Stringfellow on mechanical flight were of an exceptionally interesting character, and now that much of their apparatus has been secured for the nation, and placed on exhibition in the Science Museum at South Kensington, it is only fit that whatever is known of the men and their activities should be placed on record. Neither of them was included in the "Dictionary of National Biography", and this record, prepared by Mr Davy and fully documented, will be welcomed by every student of aeronautics wishing to know something of the history of the subject.

Henson was born in 1805 and died in 1888, while Stringfellow was born in 1799 and died in 1883. How they came to collaborate, what experiments they carried out together or separately, and what they actually achieved, are all well told, and the illustrations include not only photographs of their model machines, but also drawings from which it would be possible to construct replicas. If the Aerial Transit Company, launched in 1844 to utilise an invention "which if ultimately successful will be without parallel even in the age which introduced to the world the wonderful effects of gas and of steam", was mainly productive in providing material for the caricaturists, its failure does not detract from the merits of the inventors, whose ingenious and persevering efforts brought them very near to a success which, to-day, we know to have been beyond their reach.

*A Textbook of Physiology* By Prof William D Zoethout Fourth edition Pp 724 (London Henry Kimpton, 1931) 18s net

THE third edition of this "Textbook of Physiology" was reviewed in these columns only three years ago (NATURE, vol 123, p 379; 1929). The fact that a new edition has been called for so soon indicates that the work fills a definite gap in physiological literature. It is a medium-sized textbook, shorter than the number of pages might indicate owing to the size and clearness of the printing. It is intended to present the main facts of physiology in adequate detail, but makes no claim to supplant the larger works. A few references to monographs or reviews are given in each chapter, so that the reader who is interested is put on the track of the literature of different branches of the subject.

The author has taken the opportunity to revise the work throughout, especially the sections dealing with the central nervous system, metabolism, and the endocrine glands, in addition, a number of

new graphs, diagrams, and anatomical illustrations have been added. The application of the facts of physiology to the maintenance of health in man is frequently emphasised. Some paragraphs referring to certain human ailments serve to link the subject with medicine, so that the medical student can realise the importance of his study of physiology for his later clinical work. The book may be recommended to medical students and to others commencing the study of physiology.

*Heredity* By Prof A Franklin Shull (McGraw-Hill Publications in the Zoological Sciences) Second edition Pp xv + 345 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1931) 15s net

PROF SHULL's textbook presents the essentials of Mendelian heredity with special reference to human problems. It is intended for students, the majority of whom have no biological training and do not intend to specialise in that science, reading genetics as part of a general education. The second edition is bulkier than the first (1926), owing mainly to expansion of the chapters dealing with human inheritance. The absence of any mention of natural selection, either in the chapter on the mechanism of evolution or in the index, is surprising, for the chief problem confronting the Mendelian who sets out to explain evolution is to show how progressive modification of a race, continuing through vast numbers of generations, can be brought about by random mutation, and here the hypothesis of natural selection offers at least a plausible explanation. The recent discussions by Haldane, Fisher, Hogben, and others of the effect of selection on Mendelian populations should receive attention in this context, and would also illuminate the chapter on eugenics.

G P W

*Die Gift- und Arzneipflanzen von Mitteleuropa mit besonderer Berücksichtigung ihrer Wirkungen* Von Dr Otto Gessner Pp viii + 348 + 128 Tafeln (Heidelberg: Karl Winters Universitätsbuchhandlung, 1931) 9 50 gold marks

THIS very useful handbook of poisonous and medicinal plants differs from most other books on a similar subject in the arrangement, the balance of matter in the text, and the illustrations. The plants discussed are not arranged according to one of the well-known taxonomic schemes, but under headings of the chief active chemical constituents, such as alkaloids, glucosides, tannins, and etherial oils. Each group is prefaced by a lucid summary of its more important chemical features. Most of the text is occupied by accounts of the species native to or cultivated in central Europe and used in pharmacy or known to be, or suspected of being, poisonous. Under each species, besides a brief botanical description, the active principles are given, and usually a full account of the pharmacology, including symptoms, physiological reactions, and treatment. The work is accompanied by 128 coloured plates, of varying merit, but the majority botanically excellent and several aesthetically noteworthy, and a long index.

W B T



## Origin of the Gamma Rays\*

By the Right Hon LORD RUTHERFORD, O M, F R S

IT has long been known that some of the radio-elements emit a penetrating type of X-rays known as the gamma rays. It is clear that these radiations arising from the nucleus of the radioactive atom represent in a sense some of the characteristic modes of vibration of the nuclear structure. The wave-length and quantum energy of many of the stronger lines in the complicated gamma ray spectrum have been determined by different methods, with concordant results. It has been difficult to determine with certainty the origin of this radiation. It was at first supposed that it must arise from the motions of electrons in the nucleus, but in recent years there has been a growing belief that the radiation is connected with the transition of an  $\alpha$ -particle or proton which forms part of the nuclear structure.

It is not an easy matter to distinguish between the various hypotheses, since very little is known about the detailed structure of the nucleus. Fortunately, during the last two years, two different methods of attack on this problem have been developed. The first depends on an analysis of the groups of long-range  $\alpha$ -particles which are emitted in small numbers from radium-C and thorium-C, and the other the analysis of the fine structure shown in the emission of  $\alpha$ -rays from certain bodies. It may be supposed that the emission of a  $\beta$ -particle during a transformation causes a violent disturbance in the resulting nucleus, some of the constituent  $\alpha$ -particles being raised to a much higher level of energy than the normal. These  $\alpha$ -particles are unstable and after a very short interval fall back to the normal level, emitting their surplus energy in the form of a gamma ray of definite frequency. According to the ideas of wave mechanics, in this short interval there is a small chance that some of the  $\alpha$ -particles in the higher levels can escape from the nucleus.

On these views, the escaping  $\alpha$ -particles represent the long range  $\alpha$ -particles observed, and the energy of the  $\alpha$ -particles gives the value of the energy level in the nucleus which it occupied before its escape. Following out these ideas, the long range  $\alpha$ -particles which escape from radium-C have been carefully analysed, using the new electrical methods of counting  $\alpha$ -particles.

Nine distinct groups of particles were observed, and the energies of  $\alpha$ -particles forming each group were determined. The differences of energy between the various groups were found to be closely connected with the energy of some of the most prominent  $\gamma$ -rays in the spectrum, and, in general, the experiments gave strong evidence that the  $\gamma$ -rays had their origin in the transition of one or more  $\alpha$ -particles in an excited nucleus.

It has generally been supposed that in a radioactive transformation all the  $\alpha$ -particles are expelled

with identical speed. This is certainly the case for most bodies, but Rosenblum found that the element thorium-C emitted not one but five distinct groups of  $\alpha$ -particles. This discovery was made possible by making use of the great Paris electromagnet in order to bend the  $\alpha$ -particles into a semicircle. Gamow pointed out that the appearance of such a 'fine structure' in the  $\alpha$ -ray emission should be accompanied by the liberation of  $\gamma$ -rays.

Owing to certain experimental difficulties, it is not easy to obtain a clear-cut decision on this point. Ellis concludes from his experiments that Gamow's view is correct, but Meitner, from similar experiments, reached an opposite conclusion. In view of this difference of opinion, I have made in conjunction with Mr Bowden some experiments to throw light on this problem in another way. Recently Lewis and Wynn Williams found that the actinium emanation emitted two distinct groups of  $\alpha$ -particles differing in energy by about 340,000 volts. It was seen that this observation offered a simple method of testing the theory of Gamow. The emanation was carried by a current of air into a separate chamber and the emission of  $\beta$ - and  $\gamma$ -rays tested directly. It was found that the transformation of the emanation was accompanied by a weak  $\beta$ -radiation and a strong  $\gamma$ -radiation. The experimental results were in good accord with the theory, and thus showed that the presence of a 'fine structure' in the  $\alpha$ -ray emission is accompanied by the emission of  $\gamma$ -rays. At the same time, the results afford strong corroborative evidence that the  $\gamma$ -rays have their origin in the transitions of an  $\alpha$ -particle in an excited nucleus.

It is of interest to consider how far these views can be carried into the region of the artificial disintegration of the elements resulting from the bombardment of certain light elements by  $\alpha$ -particles. In some of these disintegrations it is necessary to assume that the  $\alpha$ -particle can be captured in different energy levels, and that a  $\gamma$ -radiation is emitted as a result of the transition between the two levels. Penetrating radiations have, in fact, been observed in several cases when light elements are bombarded by  $\alpha$ -particles. Some of these cases are of peculiar interest.

## RADIATION FROM BERYLLIUM AND THE NEUTRON

In examining the artificial disintegration of light elements under the action of  $\alpha$ -rays, Bothe and Becker in 1930 noted that beryllium under  $\alpha$ -ray bombardment did not emit protons like boron or nitrogen, but gave out a weak radiation which was more penetrating in character than the  $\gamma$ -rays from radium. The absorption of this radiation in its passage through matter was later examined in detail by Mme Curie-Joliot and M Joliot, and by Webster.

It is usual in experiments of this kind to employ active preparations of polonium on a metal disc as a source of  $\alpha$ -rays. This source is very convenient

\* Substance of the Friday evening discourse before the Royal Institution on March 18

for the purpose, as the results are not obscured by the presence of  $\beta$ - and  $\gamma$ -rays which are so freely emitted from other  $\alpha$ -ray sources such as radium-*C* and thorium-*C*

In examining the absorption of this beryllium radiation by the ionisation method, Mme Curie-Joliot and M Joliot made the striking discovery that hydrogen material, when exposed to this radiation, emitted swift protons. In explanation, they suggested that the protons gained their energy by a radiation recoil in a process similar to the well-known Compton effect, and estimated that the quantum energy of the radiation must be of the order of 50 million electron volts.

J Chadwick, using direct counting methods of great sensitiveness, found swift recoil atoms were liberated not only in the passage of the radiation through hydrogen, but also in other light elements, including helium, lithium, beryllium, carbon, air, and argon. In a letter in *NATURE* of Feb 27, he pointed out that the results in this and other directions were difficult to reconcile with the hypothesis of a quantum of radiant energy of such high frequency. He suggested that the effects observed were not due to a  $\gamma$ -radiation at all, but to the liberation from the bombarded beryllium of a stream of swift uncharged particles or 'neutrons'.

The idea of the possible existence of neutrons, that is, of a very close combination of a proton and electron to form an uncharged nuclear unit of mass nearly 1, is not new to science, but it has been very difficult to find any definite evidence of its existence. I discussed the properties of such a neutron in the Bakerian Lecture before the Royal Society in 1920, and both the late Dr Glasson and Dr Roberts made experiments in the Cavendish Laboratory to test whether neutrons were produced in strong electric discharge through hydrogen, but without success.

It is to be anticipated that a projected neutron would produce little, if any, ionisation in its passage through matter, and would pass freely through the outer structure of atoms. A swift neutron should, however, indicate its presence by the recoil of an atomic nucleus with which it collided. This recoiling nucleus would spend its energy of motion in ionising the gas, and should thus be readily detected by its electrical effect or by the trail of water drops it produces in a Wilson expansion chamber. In some respects, however, the effects produced by a neutron would be very similar to those due to a quantum of high-frequency radiation, and careful experiment is required to distinguish between them.

The velocity of the neutron at the moment of its liberation is estimated to be about  $3 \times 10^9$  cm/sec, or about one-tenth of the velocity of light. By comparison of the velocity of recoil of different atoms, Chadwick finds that the mass of the neutron is about the same as that of the hydrogen atom. In addition, the velocity of recoil of a given atom falls off when the radiation is passed through increasing thicknesses of an absorbing material like lead. This is exactly the behaviour to be expected for the neutron, but not for a high-frequency radiation.

Very valuable information on this problem can be obtained by photographing the effects due to the passage of this new type of radiation through a Wilson expansion chamber. A number of such experiments have been made by N Feather and P I Dee in the Cavendish Laboratory in association with Dr Chadwick. For example, it is to be anticipated that the neutron would occasionally collide with the electrons in its path, and thus give rise to an electron track of maximum length corresponding to twice the velocity of the neutron. This is exactly analogous to the well-known production of  $\delta$ -particles by the passage of  $\alpha$ -particles through gases.

Several such short electron tracks have been photographed by Dee which have about the right length, and for which it is difficult to suggest any other explanation. Feather has obtained photographs of more than a hundred recoil tracks produced in an expansion chamber filled with nitrogen. He has observed another very interesting effect. In addition to the straight recoil tracks, he has obtained photographs of a number of branching tracks which indicate that the nitrogen has disintegrated in a novel way. These branch tracks are believed to be produced by the recoiling nucleus and by some particle which is ejected from the struck nucleus. The identity of this latter particle has not yet been definitely established.

It will take time to analyse the results obtained, and to examine the effects produced in other gases. The peculiar properties of the neutron allow it to approach closely, or even to enter, nuclei of high atomic number, and it will be of great interest to study the effects of such collisions. It is, however, evident that this new radiation has surprising properties, and there is every promise that it may prove an effective agent in extending our knowledge of the artificial disintegration of elements. It will, for example, be of much interest to decide whether the neutron is captured in such disintegrating collisions, or whether it merely passes through the nucleus on which it has such a catastrophic effect.

Mme Curie-Joliot and M Joliot and Dee have independently noted that some swift electron tracks are observed in the expansion chamber. The exact origin and nature of these particles will require careful examination. It is possible that a  $\gamma$ -radiation is emitted from beryllium as well as the neutron. Mme Curie-Joliot and M Joliot found that the radiation from boron bombarded by  $\alpha$ -particles behaved similarly to that from beryllium. It is possible that other elements will also give rise to radiations of this kind.

Whatever may be the final explanation of the interesting facts observed, it is clear that if they are due to a quantum of radiation, we must relinquish the laws of the conservation of energy and of momentum in the production of this radiation and its inter-action with matter. If we wish to retain these laws, the neutron hypothesis seems the only alternative. In any event, it is evident that these new discoveries have opened up a new region of research which is of great interest and promise.

## Index Londinensis \*

WITH the issue of vol 6 of "Iconum Botanicarum Index Londinensis" or, for short, "Index Londinensis", the publication of this great work has been completed. Notices concerning the several volumes as they appeared will be found in earlier issues of NATURE (Jan 11 and April 5, 1930, April 18, 1931). It seems now to be the time for a comprehensive survey of the work, setting down its aims, its bearing on botany, and the development of illustration as an auxiliary for the botanical author, and, last but not least, the claims for a rational continuation of it.

When, nearly fifty years ago, Darwin provided for the publication of a catalogue of the names of the species of flowering plants, with references to their places of publication—a catalogue which has become familiarly known as the "Index Kewensis"—a step was taken which freed the taxonomist of an immense amount of labour and drudgery with one stroke. At the same time it protected him against overlapping and confusion, and guaranteed the consolidation of a widely scattered literature which before long would have become a very serious hindrance to progress. It is, in fact, difficult to visualise how botanical taxonomy could progress without such assistance as is afforded by the "Index Kewensis".

The basis of the records of this catalogue were descriptions, some complete, but many incomplete in widely varying degrees. Of these not a few were accompanied by illustrations or references to illustrations, intended to supplement the description or to support it in the most concise and comprehensive form possible by picturing the plant as a whole or essential parts of it. It is true some of these illustrations, though not indicated as such in the "Index Kewensis", were implicitly put on record by it. However, a much greater number of illustrations of the same order was contained in the pictorial literature, which under some disguise existed already or later grew up in the course of the general progress of taxonomy and its sister branches of morphology and applied botany. An attempt to catalogue the illustrations of flowering plants and vascular cryptogams was made by G. Pritzl in his invaluable "Iconum botanicarum Index locupletissimus", which appeared in 1855 and was supplemented by a second volume in 1866, but this "Index" was avowedly incomplete and for the present-day student very much out of date.

The need for a more comprehensive and up-to-date "Iconum Index" was therefore as pressing as it was undisputed. The difficulty of satisfying it was in the magnitude of the work and the expense which its execution entailed. It was evident from its compass that it could only be

undertaken at one of the few great centres of taxonomic botany and on the strength of an organisation which guaranteed the maximum of completeness, and at the same time a speed of execution that prevented its becoming long out of date before it was finished, whilst the material means required for it were such as to preclude private enterprise. Only an institution wealthy, far-seeing, and generous could risk the outlay, which was bound to be unremunerative from the commercial point of view. The institution was found in the Royal Horticultural Society of London, which rose to the occasion, providing the money for the preparation of the manuscript and securing the co-operation of the delegates of the Clarendon Press, Oxford, who took upon themselves the risk of printing, whilst the Royal Botanic Gardens, Kew, afforded all the facilities at their disposal, housing the staff and granting full use of the Library. Other institutes all over the world also lent their help when occasion required.

Attention may be directed to two features of the "Index". They concern the selection of illustrations and the correlation of the records in so far as they are affected by the conflicting nomenclature, which in the past resulted from the largely ill-organised labour of the taxonomists as a body. There is clearly demonstrated an endeavour to include as many illustrations as possible, wherever they were connected with a scientifically established name, irrespective of their often disputable claim to perfection and completeness. Also homonyms of genera and species have been sorted out and an elaborate system of cross-references for synonymous genera has been introduced. Necessarily a wide field of independent investigation has to be left open to the student, but even so much has been achieved that will save time and lead to literature which otherwise might have been ignored.

The importance of adequate illustration need not be stressed. It is self-evident, and there is the less excuse for neglecting it as a corollary to description and explanation, as the methods of illustration have been much improved, multiplied, and deprived of costliness during the last half century. If it should be argued that they still add much to the expense of publication, it should also be kept in mind that the insertion of illustrations allows in many cases the cutting down of the descriptive text, and also that illustrations may, as is indeed frequently done, be loaned from other works, a practice which will be greatly facilitated by reference to the pictorial treasure-store registered in the "Index Londinensis".

Reviewing the records of the "Index", one cannot help being struck by the largely haphazard method of illustration in taxonomic works, a vast number of genera and species being still very inadequately illustrated, whilst many others are over-illustrated. With the "Index" as a readily accessible basis it may be hoped that the innumerable

\* "Index Londinensis to Illustrations of Flowering Plants, Ferns and Fern Allies, being an emended and enlarged edition continued up to the end of the Year 1920 of Pritzl's Alphabetical Register of Representations of Flowering Plants and Ferns compiled from Botanical and Horticultural Publications of the XVIIIth and XIXth Centuries". Prepared under the Auspices of the Royal Horticultural Society of London at the Royal Botanic Gardens, Kew. By O. Stapf. Six vols (Oxford: Clarendon Press, London: Oxford University Press, 1931) 105s. net each volume.

gaps will now be gradually and methodically filled and redundancies avoided

So far, "Index Londinensis" covers the period 1753-1920 (inclusive). The earlier literature has been drawn upon only in cases where post-Linnean interpretations have lifted it into the reach of scientific nomenclature. Future studies may give occasion for further additions from this, in many respects, valuable field of botany. However, the gap left by the upward limitation of the records to the year 1920 is far more serious. More than ten years of intense activity have now elapsed. When the original issue of the "Index Kewensis" was completed, its continuation by quinquennial supplements was at once insisted upon and carried out, and their discontinuation could not now be considered, and similar consideration should be given in the case of "Index Londin-

ensis". It is already looked upon as the indispensable companion of the "Index Kewensis", and we hope it will remain so. The Royal Horticultural Society has authorised the compilation of a Supplement, intended to take in the pictorial literature for the years 1921-1935 (inclusive), and to be published by the end of 1936 or early in 1937, and it has made an initial grant for one year. The work on the supplement was begun early in 1931 and has so far resulted in a collection of more than 30,000 references, which are now accessible to the student in the Index-room of the Herbarium at Kew. It remains, therefore, to secure the guarantee of such further funds as will be required for the uninterrupted continuation of the work on the basis of, and in conformity with, the main issue, and it is most desirable that provision for this should be made without delay.

### Atmospheric Pollution\*

THE seventeenth report on atmospheric pollution issued by the Department for Scientific and Industrial Research records investigations made in Great Britain in the year preceding March 31, 1931. Observations show that the solid matter deposited from the air in twelve months in 42 towns ranges from 550 tons per square mile at one station in Lancashire down to 72 tons in Leicester, the average being more than 200 tons. Generally the observations show a reduction, especially in the sulphates, presumably due to industrial depression and reduced fuel consumption. In London, for some reason, this is not so, and some increases in atmospheric pollution are recorded.

Indeed, the report does not flatter London, which apparently will continue to have its fogs, and the records of suspended impurities do not support the current belief in the decline in the number of smoke fogs. Charing Cross is one of the worst spots, and the amount of smoke haze seems greatly to exceed that of many industrial centres, where the atmosphere by comparison is clean.

The most remarkable records come from Coventry, where on no single day was a smoke haze recorded. Now, Coventry is a large city, highly industrialised, and the circumstances therefore deserve close scrutiny. The Medical Officer advances several reasons to account for this. Coventry is not congested, and has rural surroundings without obstruction to hinder the scavenging action of the wind. The factories are on the outskirts and freely use electricity for power and gas for the heat treatment of metals. Thus there are few sources of industrial smoke, and no special smoke inspection is necessary. Moreover, the use of gas is almost universal in the kitchens there.

It may be urged, however, how will this help in the smoky cities where the heavy trades are practised? For these, the smoke laws have

always been lenient and have made no restriction on the emission of black smoke, because of the dogma that steel must be heated in a smoky furnace atmosphere. This should no longer be accepted without challenge. After protracted investigation of the influence of atmosphere on the scaling of steel, Prof. J. W. Cobb and his collaborators at the University of Leeds could not find evidence to support this belief. Indeed, no fuel seems more suitable in this respect for heating steel than a producer gas made from a high temperature coke. Experienced men in the Sheffield trades are not disposed to contest this conclusion, which, if valid, destroys the 'divine right' of the heavy trades to use smoky furnaces, however convenient it may be to do so in practice. Again, steel makers have no objection to using coal gas if the price is right. Any doubt about this is dispelled by a journey up the Ruhr Valley in Germany, where coke oven gas is freely used. The comparative cleanness of the atmosphere and the towns there makes a remarkable contrast with corresponding areas in England.

An observant traveller going north from Sheffield may first be shocked by the gross atmospheric pollution he will observe, and in a few minutes amazed by the sight of great flares of coke oven gas—a smokeless fuel—burning to waste. True, this is in process of remedy by the organisation of the South Yorkshire Gas Grid, which now has legal sanction. In general, the law hinders rather than helps the spread of gas-heating in industry, and politicians obsessed with the organisation of electrical supply have done little to assist. In this direction smoke abatement organisations might use their influence.

The report records a study of the proportions of sulphur acids in the London atmosphere, where in foggy weather the quantity of sulphur dioxide may reach one volume per million, although normally it is much less. The work indicates the growing interest in sulphur impurities, the importance of which was emphasised by the tragedy of Liège last winter. It is unlikely that the

\* Department of Scientific and Industrial Research. The Investigation of Atmospheric Pollution. Report on Observations in the Year ended 31st March 1931. Seventeenth Report. Pp. vii+110. (London: H.M. Stationery Office, 1931.) 5s. 6d. net.

absolute quantity of sulphurous impurities is increased by the concentration of power generation in central stations, but the consequences may become more serious for people and property in the immediate neighbourhood. On the other hand, this concentration of power production facilitates the application of processes for the desulphurisation of flue gases. The London Power Company claims to have worked out a practicable process by the use of lime water. Recent patent literature describes a process based on the use of ammonia, which has the merit of producing no intractable liquid effluent. Moreover, ammonia

to-day, in the form of gas liquor, is cheap and freely available. It seems fitting that the alkali from coal should be used to neutralise its sulphurous products. However, it can scarcely be doubted that the atmospheric pollution by sulphur due to boiler furnaces can be largely removed when necessary steps are taken.

The report is a voluminous document, containing much interesting matter, both descriptive and tabular. One puts it down with regret that, together with so much knowledge of the problem and its remedy, there should be so little progress towards amelioration. H J HODSMAN.

### Obituary

DR E H GRIFFITHS, F R S

DR E H GRIFFITHS, formerly principal and professor of physics in the University College of South Wales and Monmouthshire, died, after a long and painful illness, on March 3, at his residence in Cambridge, in his eighty-first year.

Dr Griffiths went to Cambridge from Owens College, Manchester, and entered at Sidney Sussex College. He took an ordinary degree in the Applied Science Special in 1873, and shortly afterwards started work as a private tutor, becoming associated with Dr Campbell, a well-known coach for the examinations in law, and at a later date with the late Mr C T Heycock. In this work he was very successful, pupils of Griffiths and Campbell usually did well in their examinations, and he was soon recognised as one who could be trusted to do his best for a lame dog.

It was not until much later (1889 or 1890) that it was realised that there was a physicist of very marked ability working almost in solitude at the Sidney Laboratory, where Neville and Heycock had been engaged on their well-known metallurgical researches. It was about this time that I first met him, when he came to the Cavendish Laboratory to ask me to standardise a resistance box he was then using—I was in charge of the British Association standards of resistance—and I then learned that he proposed to make what appeared to be a very ambitious attack on the determination of Joule's equivalent, employing the electrical method. To quote his own words from a later paper: "I commenced this work in 1887, and the general principle on which I proposed to proceed was that of eliminating the effects of conduction, radiation, etc., rather than of ascertaining the actual loss or gain due to these causes."

Griffiths' time during the next two years was devoted to preliminary work, difficulties inherent in the mercury thermometer led him to investigate platinum thermometers and the measurement of platinum temperature as introduced by Callendar in 1886.

The platinum temperature  $pt$  at any temperature  $t$  is obtained by measuring the resistance of a wire of platinum. Callendar showed (*Phil Trans Roy Soc*, A, 161, 1887) that the difference,  $t - pt$ , could be expressed in terms of  $pt$  by a formula involving

a single coefficient, and at first supposed that this coefficient was the same for all wires of reasonably pure platinum. Griffiths in his paper (*Phil Trans Roy Soc*, A, 43, 1891) proved that while the formula held with great accuracy, the coefficient varied appreciably from wire to wire—no wire was absolutely pure—so that to standardise a platinum thermometer, a third temperature in addition to the freezing and boiling points of water was required, and in a further paper (*Phil Trans Roy Soc*, A, 119, 1891) Callendar and he communicated an accurate determination of the boiling point of sulphur, and described apparatus for making use of that temperature as a third standardisation point. The platinum thermometer thus became a reliable instrument. In this way means for the accurate measurement of the temperature of the calorimeter were provided, and his real work—the determination of the mechanical equivalent of heat,  $J$ —could begin, at first in the Sidney Laboratory. Cambridge trams soon made that impossible, and a special building was erected in his own garden.

The investigation described in his paper, "On the Value of the Mechanical Equivalent of Heat" (*Phil Trans Roy Soc*, A, 361, 1893), still constitutes the standard determination by the electrical method. It may be useful to quote the values of  $J$  deduced from the results of various experimenters by Griffiths himself in the "Dictionary of Applied Physics", vol 1, 493, 1922, when reduced to the same units and on the assumption that the e m f of a Clark's cell is 1.432 volts.

#### CAPACITY FOR HEAT OF WATER AT 20° (OF THE HYDROGEN SCALE)

|                            |                         |
|----------------------------|-------------------------|
| Rowland, 1878              | 4 182 × 10 <sup>7</sup> |
| Griffiths, 1893            | 4 184 × 10 <sup>7</sup> |
| Schuster and Cannon, 1894  | 4 182 × 10 <sup>7</sup> |
| Callendar and Barnes, 1899 | 4 181 × 10 <sup>7</sup> |
| Mean                       | 4 182 × 10 <sup>7</sup> |

Any uncertainty in his result depends mainly on the uncertainty attaching to the electrical units of his day, and for the values of these he was dependent on the work in progress at the time at the Cavendish Laboratory.

For some years after this, Griffiths took an active part in discussions at the British Association and

elsewhere relating to electrical and thermal units. He became a fellow of the Royal Society in 1895, and in the same year joined the Electrical Standards Committee of the British Association. A provisional definition of the calorie as the heat required to raise a gram of water from  $9.5^{\circ}$  to  $10.5^{\circ}$  on the scale of the hydrogen thermometer, adopted at the Liverpool meeting in 1896, was the outcome of the replies sent by some twenty prominent physicists to a letter in which he urged the importance of international agreement as to thermal units.

On Griffiths' acceptance, however, in 1901 of the post of principal of the University College of South Wales and Monmouthshire, active experimental work ceased, pending the erection and equipment of a research laboratory. Administrative and educational duties absorbed his time for a number of years. At a later date the laboratory was erected, and along with Dr. Ezer Griffiths he published (*Phil. Trans. Roy. Soc., A*, **213**, 119, and **214**, 319, 1914) two papers dealing with the capacity for heat of metals over the range from  $120^{\circ}$  abs. to  $400^{\circ}$  abs. Included in the latter paper

is a comparison of their results with those given by various formulæ designed to represent consequences deduced from the quantum theory. The method employed was in every case electrical, utilising very effectively the experience gained in Griffiths' original work on *J*.

During the tenure of his principalship, Griffiths held many important positions; he was vice-chancellor of the University of Wales on three occasions, and served as president of two sections of the British Association. On his retirement in 1918 from his university offices he returned to Cambridge, and shortly afterwards became treasurer of the British Association. The death of Mrs. Griffiths the same year left him a changed man; she had been an invalid for some time, but much was hoped from a quiet life at Cambridge. However, this was not to be, and in the course of a few years Griffiths became a complete cripple, maintained alive, and to visitors happy and contented, by the care and attention of his nurse. His work was recognised by his College by his election as a fellow in 1897, and at a later date as an honorary fellow.

R. T. GLAZEBROOK

## News and Views

### Award of Duddell Medal

THE Duddell Medal of the Physical Society was presented to Prof. C. T. R. Wilson, Jacksonian professor of natural philosophy in the University of Cambridge, at the annual general meeting of the Society, held on March 18. Prof. Wilson's contributions to physical science fall mainly into two groups: those associated with the investigation of the tracks of ionising particles on one hand and the investigation of atmospheric electricity on the other. The word 'cloud' is the appropriate symbol of both groups. In 1895, Prof. Wilson discovered that clouds could be produced in a super-saturated atmosphere freed from the dust particles, which the earlier experiments of Aitken indicated as an indispensable condition for initiating condensation. Two definite critical expansions corresponding to fourfold and eightfold super-saturation were found. Using an X-ray tube which had been made by Mr. Everett in the Cavendish Laboratory in 1895, Prof. Wilson observed again the formation of fog when the expansion was between the critical values. Further experiments revealed that purely ionising agents all produced nuclei on which water condensed when, and only when, the super-saturation exceeded the lower critical limit. The condensation nuclei were shown to be ions by their behaviour in an electric field. These investigations were applied by J. J. Thomson, H. A. Wilson, and R. A. Millikan to the measurement of the ionic charge; it was also shown that the degree of super-saturation required to cause negative ions to grow into visible drops leads to the value  $4.9 \times 10^{-10}$  e.s.u. for the elementary charge.

So long ago as 1911 Prof. Wilson devised an expansion apparatus with means of instantaneous illumination of the cloud particles for the purpose

of photographing them. On the path of a primary X-ray beam he observed a large number of little patches of cloud representing the paths of very short cathode rays; these are now known to be the tracks of the recoiling electrons in the Compton effect. The final improvement of the expansion method consisted in taking stereoscopic pictures of clouds, and Blackett in particular has obtained photographs of the tracks from collisions of particles with atomic nuclei, indicating the atomic disintegration thereby produced. The work of Prof. Wilson in atmospheric electricity has opened up new and profitable fields of inquiry. His method of studying rapid changes of the earth's electric field, which is characterised by the experimental elegance evident in all his work, has led to a great increase in our knowledge of the electric fields associated with thunderstorms. His view that the earth's electric charge can be attributed to the action of thunder and shower clouds, the charges of which send negative electricity into the ground in sufficient quantity to balance the dissipation caused by the positive ion current constantly flowing to the ground, is generally accepted.

### Protection of Beneficial Insects

WHILE special laws for the protection from wanton destruction of birds useful in agriculture exist in most countries of the world, parasitic and predaceous insects which are equally, and often much more, beneficial than birds remain unprotected. The main reason, of course, was that there was no need of such protection, but recently an interesting situation arose in Mauritius. A scoliid wasp, *Tiphia*, was introduced into that island from Barbados as a means of checking the beetle *Phytalus smithi*, one of the worst



pests of sugar-cane Colonies of *Tiphia* were successfully established in several places, and the wasps began to spread, doing very useful work in the control of *Phytalus*. The beneficial effect of wasps was soon appreciated by sugar planters, who became very eager to secure the parasites for their own plantations. As a result, mass capture of the wasp and even a regular trade in them developed to such an extent that the carefully elaborated plans for a gradual establishment and spread of the parasite were in danger of being overthrown. In order to prevent this an ordinance has just been issued by the Government of Mauritius providing for the protection of any insect declared to be beneficial, and forbidding anyone to kill, injure, or molest any such insect. The declaration of an insect as beneficial rests with the Director of Agriculture, who is empowered to make surveys of private lands in order to ascertain the presence and the quantity of beneficial insects available for capture and distribution. The ordinance can be regarded as a *de jure* recognition of biological control of insect pests.

#### Federal Council for Chemistry

IN the report for 1931 of the Federal Council for Chemistry, the objects and constitution of the Council are defined with greater precision than heretofore. The objects are to foster and advance the scientific interests of chemistry in all its branches, and to that end (1) to represent the views of British chemists both nationally and internationally, (2) to co-operate with those bodies in Great Britain and the British Empire representing the science of chemistry and to co-ordinate their scientific activity, (3) to enter into scientific relations and co-operate with similar bodies in other countries, and, in particular, to act as the representative of the British associations of chemistry in the International Union of Chemistry. The report states that a sum of £1642 was collected as the contribution of chemists and the chemical industries towards one-fifth of the estimated cost of the Faraday Exhibition in 1931. The committee appointed to consider the question of forming a British chemical standardising body having reported in favour of participation in the new British Standards Institution, unanimous approval of this course has been expressed by the Council. After consideration of the report of the Bureau of Chemical Abstracts on the memorandum submitted by Sir Frederic Nathan advocating the establishment of an international system for abstracting and indexing chemical literature, the Council has reaffirmed its previous decision that the system at present in use in England is satisfactory. Under the heading of international affairs it is announced that the ninth International Congress of Pure and Applied Chemistry and the eleventh Conference of the International Union of Chemistry, which were to have been held in Madrid in April 1932, have been postponed to a more favourable time. The report of the discussion on the chemistry of the carbohydrates held at Liège in 1930 has been issued in separate form, and can be obtained from the Société de Chimie Industrielle (50 fr). During the year 1931

Russia was admitted an adherent organisation of the International Union of Chemistry.

#### Tropical Medicine and Hygiene

THE PRINCE OF WALES opened Manson House, the new headquarters in Portland Place, London, W., of the Royal Society of Tropical Medicine and Hygiene, on March 17. The premises will perpetuate the memory of Sir Patrick Manson, a pioneer in the science of tropical medicine. His Royal Highness pointed out that one of the great obstacles to the development of tropical countries is not so much the climatic conditions but the diseases which are prevalent in them. In spite of this, however, great progress has been made in the study of tropical diseases during the last thirty years. This progress has been due chiefly to the pioneer investigators who devoted their lives to the study of tropical diseases and medicine on the spot, thus saving the lives of hundreds of thousands of the inhabitants of the tropics, not only European but also the native population. One serious consideration at present is the increase in facilities for the spread of disease brought about by the improvement in communications. This problem must be attacked by the investigation of collected pathological material and the establishment of centralised research to help other centres in the investigation and control of disease. In Manson House, discoveries, experiences, and opinions of workers in tropical lands can be pooled for the help of those who will have to face similar problems in the future.

#### Climate and Soil Physics

DR B. A. KEEN, assistant director of the Rothamsted Experimental Station, delivered the G. J. Symons memorial lecture before the Royal Meteorological Society on March 16, his subject being "Soil Physics in Relation to Meteorology". Dr Keen introduced his subject with a description of the different soil types found in different climatic zones. In soil temperatures, the porous and moist nature of soil produces special effects. In particular, the downward percolation of water appreciably reduces the loss of heat from the soil. A full account was given of recent investigations at Rothamsted on the movement and distribution of water in the soil. It was shown that such movements are much less, both in amount and extent, than previously supposed. Water which has reached a depth of about six feet in the average soil is not drawn back to the surface again by evaporation. Many of the farmers' and gardeners' cultivation operations were at one time supposed to conserve this sub-soil water for use by plants, but the explanation has now to be sought for in other directions. The lecture concluded with a review of the development of cultivation implements, from the rudimentary form of a pointed stick, which merely stirred the ground, to the wide range of different types now in use.

#### The Talkatome Home 'Talkie' Equipment

HOME film projectors were popular a few years ago, but apparently silent films are becoming out of date. A demonstration was given by the British Talkatome, Ltd., at their offices at Wells Street, Jermyn

Street, London, S W 1, on March 16, of a sound apparatus for home use. The device consists of a synchronised turntable attached to the projector by a flexible drive. A special sound disc is used in conjunction with the film, and this is placed on the turntable. An electrical pick-up carries the gramophone needle, which is connected to a loud speaker either by the user's radio set or alternatively by a special amplifier. The makers have prepared 'a library of films, including comedies and travel and educational films. The device shown worked quite satisfactorily, and the operation of the equipment is simple. In some cases it might be useful in colleges and schools. The turntable is listed at twenty-five guineas, and the hire of a film from the library is 10s.

#### Witchcraft on the Gold Coast

THE Christian Council of the Gold Coast, a body consisting of representatives of all denominations, of which the Anglican Bishop of Accra is chairman, has taken the unusual course—not, however, without precedent in spiritistic circles—of issuing a challenge to witchcraft. The Council has published a notice in the local press that it is prepared to pay the sum of £10 to any person who, within the term of six months from date, will either 'eat' a papaw, or some other fruit selected by the Committee, at a distance of five yards, without coming into physical contact with it, or extract from a sealed box, without breaking the seal, an article deposited in it by the Committee, or transform himself into any beast, bird, or creeping thing. All these operations are among the powers attributed to the local witches. The Council, in making this challenge, is careful to point out that while many innocent persons are put in great terror by their fear of witchcraft, the harm from it is due not to the powers of witchcraft, but to their fear. Even with this proviso, however, the Council would appear to have been unsuccessful in its attempt to avoid criticism. Objection has been taken to its action on the ground that it constitutes 'witch-finding', and as such is contrary to a local ordinance.

EXTRACTS from the local press criticising the Council are quoted in an article describing the situation at Accra, which appeared in the *Manchester Guardian* of March 15. The Council is recommended to abstain from meddling with witchcraft, and as it does not affirm or deny the belief, it is advised "to leave the Devil alone". Apparently the Council takes its stand on precedent, for it recalls that in the last hundred years the power of 'fetish priests' has been broken in this manner on many occasions. The action of the Council is directed against 'witch-finders' as well as the witch. Some idea of the conditions with which the churches have to deal may be gained from a case quoted from the *Vox Populi*, a local journal, of Feb 20, which reports the 'finding' of a witch, who was charged with killing the child of a sister. When the dead child was placed on her lap, a snake fell from her body. This was taken as proof positive of her guilt, and the woman had to be conveyed away secretly to save her from popular vengeance.

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#### Prehistoric Society of East Anglia

AT the annual meeting of the Prehistoric Society of East Anglia, held at Norwich on Feb 29, Mr J. Reid Moir was elected president. In a paper on the evolution of the rostracarnate and hand-axe in north-east Ireland, Mr J P T Burchell described the geological conditions under which specimens he exhibited were collected. Mr J Reid Moir reviewed the typological evidence of the exhibits, showing that the line of evolution from ancestral eolithic forms and the technical methods of flaking used were identical with those in the lower palæolithic industries of widely separated regions. Dr Mur Evans exhibited a fine bone harpoon from the North Sea bed, deeply peat-stained and similar to the two examples from Holderness now in the British Museum. The specimen came from a large mass of 'moorlog' dredged up between the Leman and Ower sandbanks, about thirty-five miles east of Happisburgh lightship, by the trawler *Colinda*. Mr M C Burkitt accepted the harpoon as clearly of Maglemose type. The specimen has been presented to the Norwich Museum.

#### Fungicide for Oat Seed

EXPERIMENTS carried out at the North of Scotland College of Agriculture, at Craibstone, in 1931, clearly demonstrate the value of dressing oat seed with 'Ceresan', for on an average the yield of grain was 6 cwt and the yield of straw 8 cwt per acre higher on the treated than on the untreated plots. Ceresan is a mercuric compound in the form of a dry powder, which, when mixed with the seed, kills any fungi that may be adhering to the grain. Thorough mixing is essential if the treatment is to be successful, and special machines are now on the market for the purpose. An old churn, however, has been used at Craibstone with very satisfactory results. Mixing on the floor with a shovel is not recommended, partly on account of the difficulty of obtaining a sufficiently thorough mixing by this means, and partly because of the poisonous nature of the compound and the consequent risk of danger to live stock. Care is therefore needed in handling the powder, and if large quantities are being used, it is advisable for workmen to cover their noses and mouths as a precautionary measure. Five ounces are required for every hundredweight of seed, the cost, exclusive of labour, working out at less than one shilling per acre. Although a good stand of oats, such as was obtained on the plots where the seed had been treated, is eminently desirable, too thick a crop is liable to suffer from lodging, and it seems possible that a saving of seed could be effected if Ceresan treatment were carried out. This and other points of importance, such as the influence of weather conditions at harvest on the effectiveness of the treatment, etc., will be investigated in the experiments which are being continued at Craibstone in the present season.

#### Submerged Canyon of the Hudson River

SCIENCE Service has issued a summary of a recent United States broadcast talk on hydrographic matters, by Lieut.-Comm R R Lukens, of the United States

Coast and Geodetic Survey Among the various interesting topics dealt with, is the remarkable submerged canyon of the Hudson River, about fifty miles at sea off the entrance to New York Harbour. This great gorge, approaching in magnitude the Grand Canyon of the Colorado, is at one place more than 2400 ft deep, and three miles wide from rim to rim, it is about twenty miles long, and at its opening spreads out fan-like. It is of use during fog, as a 'seamark' for vessels equipped with sound-echo apparatus. Springs welling up in the sea are also described, both water springs and oil springs. One of the former, off the Florida coast, sends up millions of gallons of fresh mineral water from a hole about 25 ft in diameter and 70 ft deep in the ocean bed, itself 50 ft deep, the water springs up with considerable force, so that it is difficult to hold a boat over it, and it has a sulphurous smell. Elsewhere, off Alaska, the sea-bottom sounding lead, 'armed' with tallow, shows gold dust as a bottom characteristic, but the depth is too great to permit of dredging. Other remarkable ocean features off Alaska are pinnacle rocks, often extending to within a few feet of the surface, which are the cause of many shipwrecks and a submarine volcano, rising from a depth of nearly 6000 ft, which throws up islands and blasts them again with violent explosions, nearly every year witnessing some change in the appearance of the island.

#### Preservation of Chillingham Cattle

THE appeal, to which reference has been made (*NATURE*, Feb 13, p 241), has now been issued by the Zoological Society of London. Recognising the particular interest of the famous herd of white park cattle at Chillingham Castle, and the impossibility of its maintenance, under present financial conditions, by the owner, the Earl of Tankerville, the Council has taken a lease of the Park for seven years at a rental of £500 annually. Of this sum the Council has promised to contribute £100 annually for the seven years, and it appeals, through the three Trustees appointed for the purpose, for assistance in raising the balance required. The cattle herd, which has been enclosed for many centuries, now consists of forty-four animals. It has always been left to follow its own devices, so that annually a master bull fights his way to supremacy, and the retiral of the cows to calve in the woods, where they conceal their young for nearly a fortnight, recalls the habits of the wild extinct ox, or urus, which inhabited prehistoric Britain. The cattle are so wild as to be unapproachable, but arrangements have been made whereby subscribers to the fund may have entry to the Castle grounds and access to a safe place from which the herd may be viewed. Donations or annual subscriptions should be sent to the Secretary, Zoological Society, Regent's Park, London, N W 8, marked "Chillingham Cattle Fund."

#### Future Methods of Charging for Electric Supply

SIR JOHN BROOKE, vice-chairman of the Electricity Commissioners, at a conference on electric light in

architecture, organised for architects by the Lighting Service Bureau, gave an interesting address on the future charges for electricity in London. He pointed out that the aim of the Commissioners is to secure a reasonable uniformity of charge. They have chosen as a basis the two-part tariff—frequently known as the telephone system. The fixed charge is based on the floor area that has to be lighted, and they have devised a scheme for calculating this area. They suggest alternative schemes based either on the number of rooms or the rateable value of the house. In addition to the fixed charge, there is a low running charge made for the energy consumed, which is registered by the meter. He said that the tariff was not popular at first and was not generally accepted. Business men accustomed to dealing with problems of overhead charges and running costs considered it perfectly equitable that everyone who has electricity on tap should pay, in the first place, his share of the capital charges. In five years' time there will be everywhere available—if not compulsory—a two-part tariff. This is of great importance, because in considering the relative costs between minimum lighting, adequate lighting, and that generous scale we should call proper lighting, we have only to reckon on the additional running cost per unit. In the future these additional units will not cost 4d, 6d, or 8d, but will cost  $\frac{1}{2}$ d, 1d, or  $1\frac{1}{2}$ d. The reasonable anticipation that tariffs of this nature will be available in a few years' time, with a steady tendency to reduce the running charge to  $\frac{1}{2}$ d a unit, as it is in several districts in the neighbourhood of London, will obviously popularise the use of electricity for many purposes from the radio receiver to the vacuum cleaner, and make necessary the introduction of many outlet points when designing the electric wiring of a house.

#### Institution of Mechanical Engineers

THE Report of the Council of the Institution of Mechanical Engineers for 1931 states that the total membership of the Institution now stands at 11,161, an increase of 155 on that of 1930. The losses by death numbered 103, among the deceased members being Prof Archibald Barr, Sir Trevor Dawson, Sir Charles Parsons, Sir A J C Ross, and Sir Thomas Stanton. There are now eight branches of the Institution in the provinces and one in South America, and four graduates' sections, all of which have their own programmes of papers. Research work is being continued on alloys, cutting tools, marine engine trials, welding, wire ropes, and other subjects. The Institution has representatives on many boards and committees, including the Royal Society's committee for founding a memorial to the late Sir Charles Parson's. A large number of candidates were examined in England, Scotland, and Ireland for the national certificates and diplomas in mechanical engineering, and the first diplomas were issued for officers of the Royal Air Force, the examination being held in conjunction with the Board of Education and Air Ministry. The Report contains particulars of the awards made for papers read, full details of the finances of the Institution, and records the receipt of gifts, which include a replica of the memorial tablet to George Stephenson at Wylam,

a portrait of the late Sir John Thornycroft, and a commemoration medal of the late Prof. Auguste Râteau

#### Standardisation of Electric Frequency in Paris

ONE of the difficulties in connexion with the nationalisation of the British system of electric supply is the fact that many large systems are using a different frequency of supply from the chosen standard of 50. The discussion, therefore, on the standardisation of the frequency of electricity supply in Paris, held at the Institution of Electrical Engineers on Feb. 29, was a timely one. P. Rieumer exhibited a film which showed clearly how rapid the conversion had been. The Paris area extends in a circle of about thirty miles in radius around Paris. Before the War it was supplied at four different frequencies by various undertakings. In 1919 it was decided to build large modern steam-generating stations in Paris and connect them with a 60 kilovolt ring main around the city, which was also connected by transformers to the hydro-electric stations of the Central Plateau through the 120 kv and 220 kv. mains. In addition, it was decided to create a national network at a frequency of 50 which could be converted into direct current at the highest possible voltage for the electrification of the railways. Instead of having a grid round the country as in England, connected with large and efficient generating stations, France has a series of lines radiating from the principal centres of consumption. In Paris the conversion of the two-phase to direct current is carried out by rotary converters and mercury arc rectifiers. On the 25 frequency network all motors are replaced either by new or second-hand motors having twice as many poles. On the 41½ frequency network the motors have been unchanged, but the mechanical units to which they are coupled have been adapted to work at a 20 per cent increase of frequency. Luckily the motors were originally manufactured in 50 frequency frames, so it was only necessary to speed them up to the figure for which they were originally designed. Difficulty was experienced in converting small motors such as those used for calculating machines and similar apparatus.

#### Books for the Blind in the United States

THE Report of the Library of Congress, Washington, D.C., for the year ending June 30, 1931, is a volume of 463 pages, which includes a review of the activities of its various divisions and gives much interesting information regarding the books and manuscripts acquired during the previous twelve months. The total number of books and pamphlets is now 4,292,288, as against 4,103,936 in June 1930. "A new responsibility imposed upon us by legislation at the last session", says the report, "concerns the supply of books (in embossed type) for the blind." It is embodied in an Act approved on March 3, 1930, which makes an appropriation of 100,000 dollars to provide books for the use of adult blind residents of the United States. For some time past the Library has done notable work for the blind, and now has a collection of 22,655 books, periodicals, music, etc., mainly in Braille. During the year 1930-31 there

were 3359 registered borrowers and 52,222 issues of books, etc. Of this number, 39,330 were works of fiction, 2758 histories, 2444 biographies, and 739 scientific works. With the American National Red Cross, the Library of Congress maintains a Braille transcribing service for the production of Braille manuscript. Lessons are arranged for, certificates of competency are granted, and manuscripts are prepared, bound, and distributed. During 1930-31, 247,708 pages of Braille were completed and, in book form, distributed among 53 institutions, libraries, and individuals. The students helped represented 34 colleges, high schools, and universities, and assistance was given to persons engaged in many callings. But great as is the service rendered, still more is required, and "no private gifts or public funds yet in sight can meet all the growing needs of touch readers."

#### Biochemical Research in India

THE Society of Biological Chemists in India, recently founded by the enterprise of certain members of the Department of Biochemistry of the Indian Institute of Science, Bangalore, has published a review of work carried out in India during 1930 ("Biochemical and Allied Research in India in 1930" Society of Biological Chemists, India). The Society was founded to co-ordinate the work carried out in various parts of the country, and to arrange for the holding of meetings either of members of the Society alone or in association with other societies, for the exchange of ideas and the reading of papers. At present it is not proposed to issue a journal, although this may be practicable in the future as the volume of biochemical research increases. The present review, a pamphlet of twenty pages, deals with work on enzymes and fermentation, agricultural, dairy, plant, animal, and pharmaceutical and medicinal chemistry, nutrition and bacteriology. Reference is made to nearly a hundred original papers published during the year, which incidentally was the first working year of the new Imperial Council of Agricultural Research. The important work carried out by Chopra and his collaborators at the School of Tropical Medicine and Hygiene in Calcutta on the chemistry of Indian drugs, and by McCarrison at the Pasteur Institute, Coonoor, on nutritional problems is referred to, and the hope is expressed that workers will soon be attracted to the field of chemical and biological assay of drugs. The review indicates the rich field for research awaiting the attention of biochemists and pharmacologists in India.

#### The Epithalassa of the Strait of Georgia

THESE conditions have been described by A. Hutchinson and C. C. Lucas (*Can. J. Research*, vol. 5, 1931, 231-284). The Strait of Georgia is a great basin connected with the sea by narrow passages which receive water from a number of large rivers, notably the Fraser River. The water from the latter is conserved during the summer and forms a marked upper layer, the epithalassa, which is characterised by low salinity and high temperature. The temperature may be as much as 10° C. above the water of the sea. Throughout the greater part of the region this epithalassa has a stability which is sufficient to

resist tidal and wave movement Abundance of fish food in the form of plankton is present, and the amount is greatest in the region where the most complete mixing of the river and the sea water takes place The data presented are thought to have an economic bearing upon the fisheries, the establishment of oyster beds, the development of clam beaches, of crab and shrimp industries, and in the location of summer resorts

#### Seismological Society of America

THE last two numbers of *Earthquake Notes* report the proceedings of the Eastern Section of the Seismological Society of America Arrangements have been made with the directors of the Society by which it is provided that longer articles read before the Eastern Section shall be published in the Society's *Bulletin*, the *Notes* being reserved primarily for notes and news The recent numbers contain a summary of the papers that were read at the annual meeting of the Section held at Columbia, S C, on June 11-12, 1931 Most of the papers are devoted to instruments and their records, with one recalling the Charleston earthquake of 1886, some of the effects of which were seen during an excursion to that city. We have also received the last four quarterly numbers (for July 1930-June 1931) of the valuable *Bibliography of Seismology* issued by the Eastern Section, in which the titles, with occasional brief abstracts, are given of four hundred memoirs dealing with earthquakes

#### Library of the Royal College of Surgeons

A LIST has been published of the volumes in the library of the Royal College of Surgeons ("List of the Transactions, Periodicals, and Memoirs in the Library of the Royal College of Surgeons of England" London: Taylor and Francis, 1931 2s 6d) This is the second edition, the first having been published in 1890 it contains about twice as many entries as the latter Perusal of the list shows that the library contains, in addition to the commoner periodicals devoted to medical and allied sciences, a great variety of pamphlets and journals of considerable historical interest, to which access is generally difficult The list should be of value to librarians and research workers who may desire to refer to papers published in the lesser known or ephemeral journals, as well as to those interested in the history of medicine.

#### Microlepidoptera of Eastbourne

IN vol 10 (second supplement) of the *Transactions of the Eastbourne Natural History, Photographic and Literary Society* for 1931, Mr Robert Adkin contributes a carefully prepared list of the 'Microlepidoptera' and the more primitive of the larger moths of the Eastbourne district The list is annotated with many natural history details of considerable interest, and is illustrated by twenty-five excellent photographic plates giving natural-size reproductions of many of the species enumerated The list is one which will commend itself to anyone interested in the groups of insects dealt with, and is obtainable at the Society's rooms at the Technical Institute, Eastbourne, price 3s. 6d net.

No 3256, Vol 129]

#### Retting of Wool

WRITING from the Wool Research Department, Massey Agricultural College, Palmerston North, New Zealand, Mr R. Waters says "It may be of interest to those engaged in wool research to know that the fibre may be broken down into its constituent cells by retting it in a culture of what appears to be a variety of *Bacillus vulgatus*, and that this process may conveniently be used to provide cell material for study The organism apparently does not attack the cells, the material obtained appearing quite normal" Details of the technique employed may be obtained from Mr Waters

#### Announcements

PROF E S GOODRICH, Linacre professor of zoology and comparative anatomy in the University of Oxford, has been selected by the Council of the Linnean Society of London as the recipient of the Linnean Medal, which will be presented to him at the anniversary meeting on May 24

It is announced in the *Fight against Disease*, the quarterly journal of the Research Defence Society, that the Hon Sir Arthur Stanley has accepted the chairmanship of the Society in succession to the late Lord Knutsford

It is announced in *Science* that Dr T W Stanton, geologist in charge of palæontology and stratigraphy in the United States Geological Survey, has been appointed chief geologist, succeeding Dr W C Mendenhall, who has become director of the Survey

MESSRS W and G Foyle, Ltd, 119 Charing Cross Road, W C 2, have just circulated a catalogue of medical books offered for sale by them, which many readers should find useful

A COPY of catalogue No 3, 1932, of Messrs Oppenheim and Co (Rare Books), Ltd, 317A Fulham Road, S W 10, has reached us It gives the titles of about 900 works dealing with science, and is particularly strong in sets and long runs of publications of the learned societies

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A lecturer in education in the University of Manchester—The Registrar, The University, Manchester (April 2) A full-time engineering workshop instructor at the L C C Paddington Technical Institute—The Education Officer (T 1), County Hall, S E 1 (April 2) An assistant lecturer in pharmacy at the Bradford Technical College—The Principal, Technical College, Bradford (April 6) A professor of physics at University College, Southampton—The Registrar, University College, Southampton (April 16) A chief metallurgist for the Tata Iron and Steel Company, Jamshedpur, India—Tata, Ltd, Capel House, New Broad Street, E C 2 A head of the department of mechanical and structural engineering and building of the Borough Polytechnic, Borough Road—The Principal, Borough Polytechnic, Borough Road, S E 1.

### Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

#### Spectrographic Observations of Infra-Red Lines in the Auroral Spectrum

THE importance of obtaining auroral spectra in the infra-red has long been recognised, and such investigations have formed part of my spectroscopic programme for the new auroral observatory at Tromsø. Preparations were made last summer and through Dr Brucke and Dr Lacmann, of Berlin, I was recommended to use Agfa Infra-Red Plate 810 with a suitable

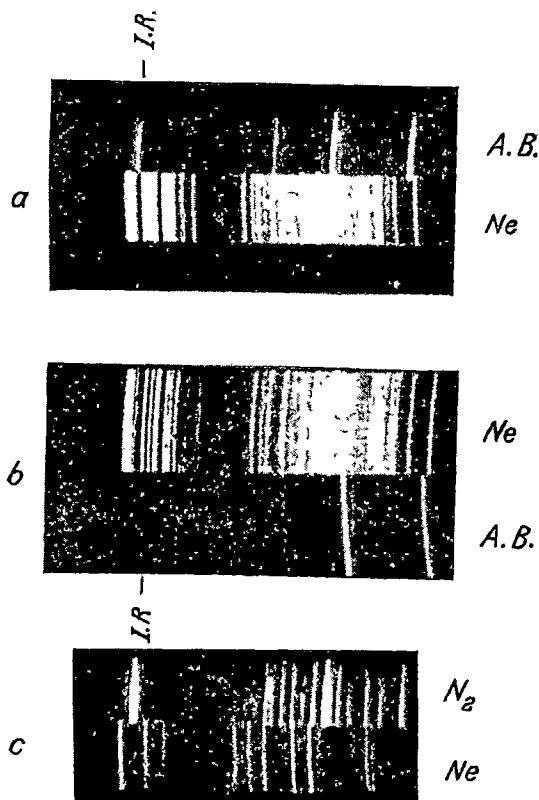


FIG 1

sensitiser. These plates were tested last autumn and found suitable. After having carried out some precision interferometer measurements of the wave-length of the auroral line 5577.35<sup>1</sup>, spectrographic exposures of the aurora with infra-red plates of the kind mentioned were begun under the guidance of Mr L Harang.

During an auroral display on Feb 4, two small glass spectrographs were in operation, each of them gave good spectrograms showing strong lines in the infra-red, and the well-known spectrum in the blue part. The strong green line is absent because the plate is very insensitive in that region.

The spectrogram (a) of Fig 1 gives the strongest lines, and was taken with a broad slit. As the neon comparison spectrum is somewhat overexposed, it is to be expected that this plate will give a less accurate wave-length determination than the spectrogram (b) taken with a narrow slit. Our wave-length deter-

minations will therefore be based on the latter spectrogram.

The spectrum in the infra-red has the appearance of one strong and one weak narrow band with sharp edges towards long wave-lengths. They have very much the appearance of band sequences belonging to the first positive group of nitrogen.

On account of the small dispersion in this region (1400 Å/mm on the original plate), wave-length determinations cannot claim any great accuracy. In order to estimate the possible error, we measured the strong lines 4208 and 3913, and we obtained the values 4207 and 3912 respectively. The average dispersion in this region is 122 Å/mm and the error of A. should correspond to 12 Å in the region of the infra-red auroral lines.

The wave-lengths found for these two infra-red auroral lines are  $\lambda = 7883$  strong,  $\lambda = 8095$  weak.

If the auroral line 5577 is to be identified with the oxygen line observed by McLennan, we should expect a number of oxygen lines to appear in the infra-red. The most prominent oxygen lines are the first principal triplet of the Runge-Paschen series (7772, 7774, 7775), the three triplets of the series of Kiess, one between 8233 and 8221, the second between 7952 and 7948, and the third between 7481 and 7476.

None of these oxygen-lines can be identified with the two infra-red auroral lines.

Nitrogen shows a spectrum in the infra-red very similar to that of the auroral spectrum (Fig 1 c), which belongs to the first positive group. For the wave-length of the strongest heads we find  $\lambda = 7722$ , and this cannot be identified with the strongest head of the auroral infra-red spectrum.

On account of the large intensity of the infra-red auroral lines, only oxygen and nitrogen can come into consideration. As they are not (O I) lines, they most likely must be referred to nitrogen. As the positive group appears fairly strongly in the auroral spectrum, it is to be expected on account of the mutual relation between the first and second positive group that the first positive group should also appear fairly strongly in the infra-red.

If we write the formula for the first positive group:

$$\nu = 10979 + 1718 4n_1 - 14 44n_1^2 - 1474 4n_2 + 13 98n_2^2,$$

then the strongest head in the infra-red auroral spectrum nearly coincides with lines of the first positive group corresponding to the following transitions

| $n_1$ | $n_2$ | $\lambda$ |
|-------|-------|-----------|
| 1     | 0     | 7885      |
| 7     | 7     | 7896      |
| 12    | 13    | 7863      |

The last transition can scarcely come into consideration.

In order to settle the question as to the exact interpretation of the infra-red auroral spectrum, we shall have to wait for more accurate determinations. Observations with a spectrograph of much larger dispersion are now in progress.

Physical Institute, Oslo,

Feb 22

L VEGARD

<sup>1</sup> NATURE, 129, 23, 1932

#### Origin of the Coronal Lines

THE spectrum of neutral oxygen has been analysed by Runge, Paschen, Hopfield, McLennan, and especially by Frerichs<sup>1</sup>. The deep terms  $^3P_{210} = 109837.3$ ,  $109679.2$ ,  $109610.5$ ,  $^1D_2 = 93970.3$ ,  $^1S_0 = 76045.6$  account for the green and red lines in aurora and nebulae ( $\lambda\lambda 5577$ ,  $6300$ ,  $6364$ ). Still, there are a few



isolated lines of groups in the spectrum unclassified and not connected by known terms. These groups are

- I (4)6654 121, (5)6374 292, (4)6366 282  
 II (1)6266 692, (2)6264 346, (5)6261 314, (1)6258 965, (3)6256 616  
 III (3)5995 198, (1)5993 102, (2)5991 852, (1)5991 255

Now the last group has been found to be a combination between the known term  $3p^3P_{21}$  (-3456 4, -3459 8) and a new term  $3D_{321}$  (-20135 2, -20141 1, -20142 8). This new term also combines with the ground triplet  $2p^3P_{210}$  and accounts for the unclassified lines, (0)770 70, (1)770 28, (2)679 39 in the far ultra-violet

The groups II and I can be connected by the term difference  $\Delta\nu = 19.8$  and interpreted as combinations between a new set of deep levels  $P = 94925.1$ ,  $Q = 94905.3$ ,  $R = 94898.7$ ,  $X = 79221.7$ ,  $Y = 78946.2$ ,  $Z = 78932.3$ . The line 6654 ( $Y^1D_2$ ) forms the link with the  $1D_2$  metastable level that involves the green and red lines in aurora and nebulae. The red coronal line 6374 29 is the  $XQ$  combination. Hopfield has already directed attention to the fact that this line may be interpreted as the unclassified oxygen line.<sup>2</sup> The newly detected red coronal lines,  $\lambda(2)6704$  (Grotrian 1929) and  $\lambda(8)6776$ ,<sup>3</sup> have the difference  $\Delta\nu = 158$ , that occurs in the  $2p^3P_{21}$  ground triplet of neutral oxygen, and form the combinations  $2p^3P_2 - 8P$  and  $2p^3P_1 - 8P$ .

It is now also possible to calculate from laboratory data the green coronal line 5303, known since 1869, but never identified, notwithstanding numerous attempts. All the strongest coronal lines in the visible spectrum are now connected with terms of neutral oxygen. The Zeeman effect of the line 6374 will possibly give us the nature of the new terms. It may be that the configuration  $sp^4$  plays a rôle

| CORONAL LINES |                           |                                |            |               |                                                                  |
|---------------|---------------------------|--------------------------------|------------|---------------|------------------------------------------------------------------|
| Int           | $\lambda$ obs<br>(Corona) | $\lambda$ calc<br>(Laboratory) | $\nu$ calc | Combination   | Author                                                           |
| 8             | 6775.90                   | 6775.90                        | 14754.1    | $2p^3P_1 - P$ | Mitchell, <i>Astr. J.</i> , 1, 1932                              |
| 2             | 6704                      | 6704.07                        | 14912.2    | $2p^3P_2 - P$ | Grotrian, <i>Z. Astr.</i> , 2, 106, 1929                         |
| 12            | 6374.28                   | 6374.29                        | 15683.6    | $Q - X$       | Mitchell, 1932                                                   |
| 20            | 5302.78                   |                                |            |               | Campbell and Moore, <i>Lick Obs. Bull.</i> , x, 318, p. 13, 1918 |
|               | $5302.8 \pm 0.2$          | 5302.70                        | 18853.1    | $R - 2p^1S_0$ | Davidson and Stratton, <i>Mem. R. A. S.</i> , 64, 141, 1927      |
|               | $5302.6 - 5303.4$         |                                |            |               | Mitchell, 1932                                                   |

It should be noticed that the green auroral line 5577 and the green coronal line 5303 both have their origin in the same metastable level of the neutral oxygen level,  $1S_0$ . The mysterious 'coronium' turns out to be neutral oxygen.

In the near future we hope to publish a more extensive report on the spectrum of the solar corona.

T. L. DE BRUIN

Laboratory "Physica" of the University of  
Amsterdam, March 11.

<sup>1</sup> *Phys. Rev.*, 34, 1239, 1929, 36, 398, 1930

<sup>2</sup> *Phys. Rev.*, 37, 160, 1931

<sup>3</sup> Mitchell, *Astr. J.*, Jan 1932

### Passage of Neutrons through Matter

THE discovery by Dr J. Chadwick<sup>1</sup> of strong experimental evidence in favour of the existence of neutrons of mass approximately that of the proton makes it imperative that as many lines of attack as possible on the problem of determining the nature of this particle be developed. Thus, it is clearly very important to determine the nature of the field surrounding the particle. In order to investigate this, the simplest method is to examine the interaction of a neutron with other material particles such

as atomic electrons. Thus, the measurement of the number of ions produced per centimetre by neutrons of different velocity should lead to a method of determining the field. It has therefore been thought of interest to give a preliminary account of the results of theoretical calculations of the behaviour of possible neutrons in this respect.

As the mass of the neutron is nearly that of a hydrogen atom, it cannot be the one suggested by

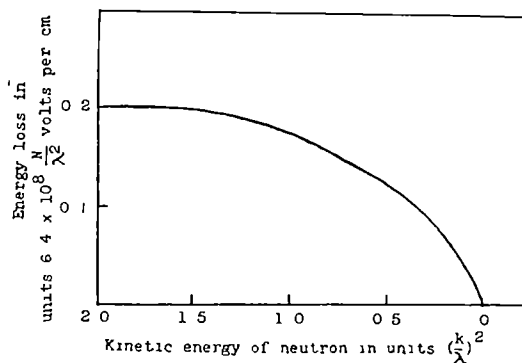


FIG. 1

Pauli,<sup>2</sup> which has a smaller mass. The only models which seem at all likely for the particle are as below.

(a) A hydrogen atom in nearly zero quantum state. This possibility was discussed in 1920 by Lord Rutherford,<sup>3</sup> and experiments were actually carried out by Glasson<sup>4</sup> in the following year in order to ascertain if such particles occurred in discharge tubes. Recently, Langer and Rosen<sup>5</sup> have discussed this model from the point of view of quantum theory.

For such a system the interaction energy between an electron and a neutron would be of the form

$$e^2 e^{-\lambda r},$$

where the parameter  $\lambda$  would be connected with the energy of binding  $-E$  ergs, by some formula of the type

$$\lambda^2 = \frac{8\pi^2 m^* E}{\hbar^2}$$

The mass  $m^*$  would probably be nearly that of an electron, but, as the binding energy is almost certainly greater than the rest mass of the electron, it is somewhat doubtful what mass one should take.

(b) A dipole of strength  $a \sim 10^{-13}e$ . This model would seem to be less likely than the first.

Using the first and more probable model, the rate of loss of energy in collisions with electrons per centimetre path of a neutron in passing through a gas containing  $N$  electrons per c.c. has been calculated. It is found that this loss of energy is given by

$$-\frac{dT}{dx} = \frac{2\pi e^4}{mv^2} N \left\{ \log \frac{\lambda^2 + 4k^2}{\lambda^2} - \frac{4k^2}{\lambda^2 + 4k^2} \right\},$$

where  $m$  is the mass of the electron,  $\lambda$  is the field parameter defined above,  $v$  is the velocity of the neutron, and  $k = 2\pi Mv/\hbar$ ,  $M$  being the mass of the neutron. This formula is valid provided the velocity of the neutron is greater than the orbital velocity of the atomic electrons.

The interest of the above result lies in its difference from the corresponding formula for charged particles. Thus, for  $k < \frac{1}{2}\lambda$ , the above expression shows that the loss of energy decreases with decrease of velocity, a result very different from the case of, say,  $\alpha$ -particles. When  $k \approx \lambda$ , the variation with velocity is very slow,

and for  $k \gg \lambda$  the behaviour resembles that of a charge (this depends on the assumptions made regarding the internal field). This behaviour is illustrated in Fig 1

The peculiar form of the above expression lends itself readily to at least qualitative experimental test, and may help to determine the field of a neutron. The calculations are being extended to other models and to the consideration of nuclear collisions

H. S. W. MASSEY

Cavendish Laboratory,  
Cambridge

<sup>1</sup> NATURE, 129, 312, 1932

<sup>2</sup> Vide Carlson and Oppenheimer, *Phys. Rev.*, 38, 1787, 1931

<sup>3</sup> Bakerian Lecture, *Proc. Roy. Soc. A*, 97, 374, 1920

<sup>4</sup> *Phil. Mag.*, 42, 596, 1921

<sup>5</sup> *Phys. Rev.*, 37, 1579, 1931

### Radioactive Disintegration and Nuclear Spin

It is well known that in radioactive disintegration, an  $\alpha$ -particle escaping from the nucleus has to cross a potential barrier formed at great distances by Coulomb repulsion forces and at small distances by attractive forces of yet unknown nature. Wave mechanics permits us to calculate the transparency of such a barrier and to obtain the formula connecting the decay constant  $\lambda$ , the velocity  $v$  of the ejected  $\alpha$ -particle, the charge number  $Z$  of the disintegrating element, and the radius  $r_0$  of the internal nuclear region <sup>1</sup>

Using the experimental values of  $Z$ ,  $v$  and  $\lambda$ , it is possible to calculate the radii of different radioactive nuclei which are shown in Fig 1. For the thorium

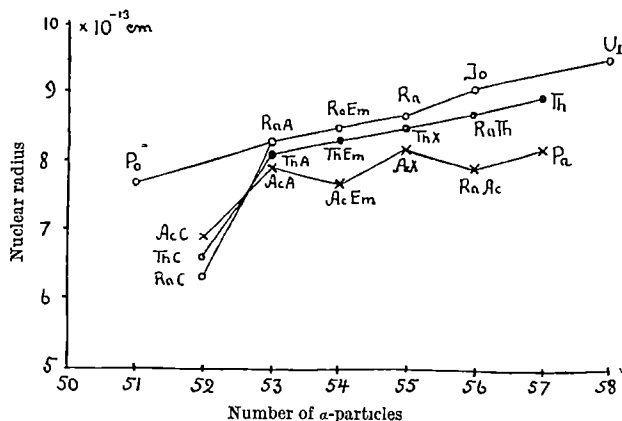


FIG 1

and uranium families the values of the nuclear radii vary rather regularly with increasing atomic weight, whereas for the actinium family a number of irregularities is present. This may be either because the radii of this family really do vary irregularly, or because all the factors are not taken in account by the calculations.

In the formula by means of which the values of radii shown in Fig 1 have been calculated, the angular momentum  $l$  of an escaping  $\alpha$ -particle was supposed to be zero. The presence of angular momentum increases the height of the potential barrier (the centrifugal force added to the Coulomb forces) and gives smaller values of the decay constant for the given  $r_0$ , or, the other way round, the neglect of this momentum leads to too small values of the radius, which is just the case for some members of actinium family. On the other hand, if nuclear spins of different elements which have been investigated are examined, it is seen that the nuclei with even atomic weights (to which the thorium and uranium families belong) usually have no spin at all, whereas for those with odd atomic

weights (for example, the actinium family) the nuclear momenta can take rather different values (from  $\frac{1}{2}$  up to  $\frac{5}{2}$ ).

If the nuclei of the elements which are disintegrating and their products have different spins, the ejected  $\alpha$ -particles must have angular momentum. The formula for the decay constant can be, in this case, written in the form

$$\lambda_j = \frac{\pi \hbar}{2mr_0^2} e^{-\frac{4\pi e^2}{\hbar} \frac{(Z-2)}{v} + \frac{8e\sqrt{m}}{\hbar} \sqrt{(Z-2)} \sqrt{r_0(1-\sigma)}} \quad (1)$$

$$\sigma = \frac{\hbar^2 j(j+1)}{2m r_0^2} \frac{2(Z-2)e^2}{r_0} = 0.002j(j+1),$$

where  $\hbar$  denotes (Planck's constant)/ $2\pi$

Using this formula we can, for example, estimate the correct value of the atomic radius of actinium emanation by ascribing to the  $\alpha$ -particle escaping from this nucleus an angular momentum of about three units, which means that the difference between the nuclear spins of actinium emanation and actinium-A is about  $\frac{3}{2}$ .

Such calculations, although uncertain, can give some idea of the spins of radioactive nuclei. Considerations of the same kind can also be applied to the decay processes when escaping  $\alpha$ -particles leave the nucleus in an excited state, <sup>2</sup> although in these cases the estimations must be still more uncertain owing to the increase of the nuclear radius by excitation.

Club of Scientists,  
Leningrad, Feb 8

G. GAMOW

<sup>1</sup> G. Gamow, "Constitution of Atomic Nuclei and Radioactivity," Oxford, 1931.

<sup>2</sup> G. Gamow, NATURE, Sept 13, 1930

### Molecular Structure of Polysaccharides

IN the issue of NATURE of March 5, Prof W. N. Haworth announces that he has isolated tetramethyl glucose by hydrolysis of a fully methylated cellulose, and, on the basis of this result, he makes certain suggestions regarding the probable dimensions of the cellulose chain. In addition, he states that he is undertaking a similar research on other polysaccharides, and the letter closes with a claim for reservation.

It ought not to be necessary to point out that this laboratory, in which the methylation process was developed and first applied to all types of carbohydrates, has been engaged continuously for more than twelve years on the general problem now included in Prof Haworth's reservation. The results reported by him, and others of a similar nature, have been known to us for a considerable time, but we have good grounds for the opinion that the interpretation of these results is beset with so many complications that early publication is inadvisable. At regular intervals during the past four or five years, however, the results have been communicated to the expert referees of the Carnegie Trust, which has, in part, financed the work.

In the circumstances which have emerged it appears to be desirable, in the interests of my collaborators, to synopsise, so far as this is expedient, some of the results already obtained by us.

**Cellulose**—When cellulose is methylated on a large scale and the product subjected to *graded hydrolysis*, only 2, 3, 6-trimethyl glucose is liberated in the first instance, the 2, 3, 4, 6-tetramethyl glucose being derived from the more resistant fraction of the methylated cellulose. It is still an open question if this result can be interpreted as a proof that cellulose possesses a long-chain structure, or if the amount of tetramethyl glucose formed can be used as the basis of calculating the length of the cellulose chain as a whole. This work has been conducted, with numerous variations, on cellulose derived from

five distinct sources and on material specially prepared in the Forest Products Research Laboratory

**Starch**—The corresponding results which we have obtained with starch vary according to several factors for example, the nature of the amylose used and whether the material is methylated directly or is subjected to a preliminary acetylation. When the hydrolysis of methylated amylose is carried out in stages, tetramethyl glucose can be detected in amounts varying from 3 to nearly 5 per cent, but of much greater importance is the observation that one fraction of the methylated amylose is convertible into a mixture of sugars, the composition of which varied within the following limits

|                               |                |
|-------------------------------|----------------|
| 2 3 4 6-Tetramethyl glucose   | 23-26 per cent |
| 2 3 6-Trimethyl glucose       | 55-52 per cent |
| 2 3- and 2 6-Dimethyl glucose | 21 per cent    |

This indicates that the group responsible for the formation of tetramethyl glucose forms part of a complicated fragment of the amylose complex, as otherwise no dimethyl glucose would be formed from a fully methylated derivative. We have shown that this dimethyl glucose is a mixture of 2 3- and 2 6-isomerides in approximately equal proportions when the amylose has been methylated directly, but this ratio is disturbed to 24 and 76 per cent respectively as the result of preliminary acetylation. This, in itself, indicates the extreme caution which must be exercised in applying the methylation method in conjunction with acetylation to polysaccharides.

**Inulin**—Trimethyl inulin when hydrolysed with oxalic acid yields, in addition to trimethyl  $\gamma$ -fructoses, a mixture of (a)  $\omega$ -methoxy-5-methylfurfural, (b) tetramethyl  $\gamma$ -fructose and (c) a trimethyl anhydrofructose. We find that the yields of tetramethyl  $\gamma$ -fructose have varied from 2.7 as a maximum to 1.7 per cent as a minimum, owing to partial conversion of the sugar into the furfural derivative. If all of the above products be calculated as tetramethyl fructose, inulin would consist of a chain of 25 fructose units, whilst taking the above yield of 2.7 per cent as a basis, the inulin molecule would contain 43 fructose units in the chain.

We have encountered so many complications in our studies of methylated polysaccharides (including the unexpected result that certain  $\gamma$ -fructose derivatives are readily transformed into derivatives of glucose) that we are reluctant to make far-reaching claims on the basis of having isolated such compounds as tetramethyl glucose and tetramethyl fructose under the conditions described, but this communication will serve to show the progress we have made recently in researches which were initiated in this laboratory and have not been discontinued.

J C IRVINE

Chemical Research Laboratory,  
The University, St Andrews,  
March 12

### Vertical Tube Counter- and the Barometric-Effect of Cosmic Radiation at Sea-level

TURNING a long tube counter in a perpendicular plane, the number of recorded cosmic ray particles depends on the angle  $\alpha$  between the vertical direction and the axis of the tube. This vertical tube counter effect, first observed by Tuwim<sup>1</sup> at Potsdam, has now been measured more precisely and found to be in accordance with his theory of this phenomenon.

The number  $N_{\mu H}(\alpha^\circ)$  is proportional to  $\sin^2 \alpha$ , as shown in Fig 1. This straight line enables the elimination of experimental errors of the single measurements, and therefore the fraction  $N_{\mu H}(0^\circ)/N_{\mu H}(90^\circ)$  and the mean mass absorption coefficient of the cosmic

radiation can be found more exactly than before. In a lead screen, 10 cm thick, the coefficient was found to be  $(\mu/\rho)_{H_2O} = 8.01$  and  $8.12 \times 10^{-4} \text{ cm}^2 \text{ gm}^{-1}$  with the two tube counters No 21 and No 22 ( $r = 2.4$ ,  $l = 45.0 \text{ cm}$  and  $46.0 \text{ cm}$ ) respectively, in accordance with Tuwim's value  $(9 \pm 1) \times 10^{-4} \text{ cm}^2 \text{ gm}^{-1}$  obtained with tube counter No 15 ( $r = 2.4$ ,  $l = 15.3 \text{ cm}$ ).

Repeating the experiments in the open air at different barometric pressures, the straight line of the vertical tube counter effect is shifted parallel, showing thus the barometric effect<sup>2</sup> very clearly. Assuming a pure absorption phenomenon for this behaviour,<sup>3</sup> the mean absorption coefficient is  $(\mu/\rho)_{H_2O} = 1.67 \times 10^{-3} \text{ cm}^2 \text{ gm}^{-1}$ . From the vertical tube counter effect it was found to be  $(\mu/\rho)_{H_2O} = 1.69 \times 10^{-3} \text{ cm}^2 \text{ gm}^{-1}$  in the open air.

By two different methods, therefore, it is possible to measure accurately the absorption coefficient of cosmic

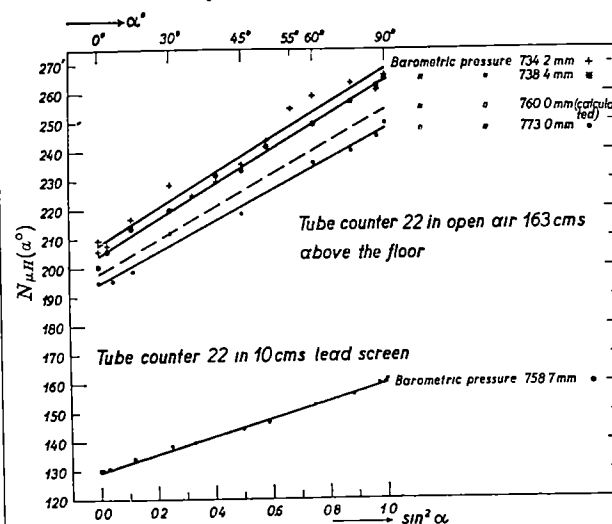


FIG 1

radiation with the same apparatus and at the same time, but without a special screen indispensable for the usual method of determining absorption coefficients.

The accordance of the two values for the open air confirms the theory of the vertical tube counter effect, and should be interpreted by this theory that the direction of the cosmic rays, acting in the counter, is not greatly different from the initial direction of the rays entering the atmosphere. The conflicting results of Skobeltzyn<sup>4</sup> with the Wilson chamber are therefore probably due to the greater statistical uncertainty of his measurements, for, according to him, no vertical tube counter effect of the cosmic radiation can exist.

W KOLHORSTER

Hohenstrahlungslaboratorium des  
Meteorologisch-Magnetischen Observatoriums,  
Potsdam, Jan 31

- <sup>1</sup> L. Tuwim, *Berlin, Ber* 91, 360, 1931
- <sup>2</sup> L. Mysowsky and L. Tuwim, *Z. Physik*, 39, 146, 1926
- <sup>3</sup> W. Kolhorster and L. Tuwim, *Erg. kosm. Physik*, 1, 127, 1931
- <sup>4</sup> D. Skobeltzyn, *C. R.*, 194, 118, 1932

### Molecular Refraction of Nitrobenzene

THE discontinuities observed by Mazur in certain physical properties of nitrobenzene in the neighbourhood of  $9.5^\circ \text{C}$ , and described in a series of communications to NATURE, call for further investigation. The sharp decrease in the dielectric constant<sup>1</sup> at  $9.6^\circ \text{C}$ , the distinct retardation in the heating curve<sup>2</sup> at  $9.5^\circ \text{C}$ , and the change in slope of the density-

temperature curve<sup>3</sup> at the same point suggest the existence of two forms of nitrobenzene

It seemed of interest to ascertain if any change in molecular refraction is observable in the neighbourhood of this temperature. Having a supply of B D H 'purified nitrobenzene' at my disposal, it was decided to carry out a few tests with it. It melted sharply at 5.3° C, a temperature 0.2° below that of Mazur's specimen. Its density (in air) was determined pycnometrically, with the following results

| t °C | Density | t °C | Density |
|------|---------|------|---------|
| 6.6  | 1.2168  | 15.4 | 1.2082  |
| 8.0  | 1.2159  | 24.4 | 1.1994  |
| 11.0 | 1.2127  | 26.1 | 1.1977  |
| 11.4 | 1.2122  | 29.6 | 1.1943  |
| 13.4 | 1.2101  |      |         |

The density  $d$  at any temperature can be calculated with considerable accuracy from the equation,  $d = 1.2233 - 0.00098t$ , for, when plotted against the temperature, a rectilinear curve is obtained. The results agree very closely with those of Tyrer<sup>4</sup> over his range of 13°-30° C, and also with the very recent data of Massy, Warren, and Wolfenden<sup>5</sup> over their range of 6°-14° C. These latter data had not been published when my experiments were carried out, in neither set of results is there any indication of discontinuity within the temperature ranges examined. The equation gives 1.2037 for the density at 20° C, which agrees closely with 1.2039 given in the International Critical Tables.

The refractive index was determined using sodium light, with a Pulfrich refractometer, the zero of which was checked against carbon disulphide and bromo-naphthalene. The results in the accompanying table were obtained

| Temperature °C | Refractive Index, $n$ | Molecular Refraction |
|----------------|-----------------------|----------------------|
| 6.4            | 1.55972               | 56.60                |
| 8.6            | 1.55893               | 56.62                |
| 9.2            | 1.55858               | 56.61                |
| 10.5           | 1.55786               | 56.60                |
| 13.5           | 1.55653               | 56.60                |
| 15.1           | 1.55565               | 56.59                |
| 20.6           | 1.55299               | 56.57                |

The value for  $n$  at 20.6° closely approaches the value 1.55291 for 20° given in the International Critical Tables (vol. 7).

The third column gives the molecular refraction calculated from Gladstone and Dale's formula,  $\frac{M(n-1)}{d}$ , where  $M$  is the molecular weight, taken as 123.07, and  $d$  the density as calculated with the aid of the equation given above.

The molecular refraction shows merely a minute and steady change with the temperature, amounting in all to approximately 0.1 per cent. These results, coupled with those of Massy and his co-workers, indicate that ordinarily 'pure' nitrobenzene exhibits no apparent discontinuities in such physical properties as have been examined in the neighbourhood of 9.5° C. To what cause, then, may the remarkable observations of Mazur be assigned?

J. NEWTON FRIEND.

Technical College, Birmingham,  
Feb. 4

<sup>1</sup> Mazur, *NATURE*, 126, 993, 1930.  
<sup>2</sup> Wolfe and Mazur, *NATURE*, 127, 741, 1931.  
<sup>3</sup> Mazur, *ibid.*, p. 893.  
<sup>4</sup> Tyrer, *Trans. Chem. Soc.*, 105, 2544, 1914.  
<sup>5</sup> Massy and others, *J. Chem. Soc.*, 91, 1932.

### Hyperfine Structure of the Mercury Line 5471 Å

In an attempt to explain the observed complicated structure of the mercury arc lines, Venkatesachar and Sibaiya<sup>1,2</sup> first suggested nuclear moments of 1/2 and 3/2 for the various isotopes of mercury. More recently, Schuler and Keystone<sup>3</sup> in Germany and Murakawa<sup>4</sup> in Japan have explained the structure of some prominent mercury arc lines by ascribing a nuclear moment of 1/2 to the odd isotope with atomic weight 199 and 3/2 to that with 201.

Though the mercury arc lines have been analysed by a number of investigators, a re-examination of the lines has revealed in some cases the indubitable existence of satellites that have not been previously recorded. It is realised that one has to be very cautious before being certain of the existence of new satellites, often faint, in the case of lines that have been carefully examined by others. It is concluded, however, that even the line 5461 ( $6^3P_2 - 7^3S_1$ ) has undoubtedly one more satellite at  $-0.154 \pm 0.002$  Å. The structure was examined in a low density, long column mercury arc, using as the resolving apparatus fused quartz etalon plates (specially made by Messrs Adam Hilger, Ltd.) of 2 mm and 3 mm thickness, suitably silvered on both sides. The microphotometer record (kindly taken by Messrs Carl Zeiss) of the pattern obtained by using the 3 mm etalon reproduced in Fig. 1, shows clearly the position of the new satellite. Besides, the existence of a satellite in this region has been suspected by Lunell<sup>5</sup> so early as 1911, and later by Schrammen<sup>6</sup> in 1927. But so definite a satellite does not work into the Schuler-Keystone scheme even as a forbidden satellite.

Again, the line 5770 ( $6^1P_1 - 6^3D_2$ ) has shown a structure containing three additional satellites at  $-0.173$ ,  $-0.213$ , and  $-0.257 (\pm 0.003)$  Å. These new satellites for 5770 along with the complex structures of 4916 ( $6^1P_1 - 8^1S_0$ ) and 5026 ( $6^1P_1 - 7^3S_1$ ), recently given by Venkatesachar and Sibaiya,<sup>7</sup> indicate that the common level  $6^1P_1$  is more complicated than is assumed by Schuler and Keystone.

L. SIBAIYA

Central College,  
University of Mysore,  
Bangalore, Feb. 12

<sup>1</sup> *Mys. Univ. J.*, 4, 145-148, 1929.  
<sup>2</sup> Sibaiya, "Revision of the Hyperfine Structure Data of some Prominent Mercury Lines" (abstract), 19th Ind. Sci. Cong., 1932.  
<sup>3</sup> *Z. Phys.*, 72, 423-441, 1931.  
<sup>4</sup> *Z. Phys.*, 73, 366-375, 1931.  
<sup>5</sup> *Ann. Physik.*, 34, 505, 1911.  
<sup>6</sup> *Ann. Physik.*, 83, 1161-1199, 1927.  
<sup>7</sup> *Naturwissenschaften*, 19, H. 52, S. 1041-1042, 1931.

### Hibernation of Adders

THE hibernation of adders and the mechanism of the process are very little understood. To all intents and purposes there is an apparently complete suspension of vital activity, but from the biological point of view this cannot be, as the nutrition of the body tissue must go on. Recently while engaged in dissecting an adder, I preserved a portion of the lung tissue and had it sectioned in the usual way. Microscopic examination of several sections showed extensive deposits of adipose tissue immediately surrounding the tracheal ring. Similar islets of fatty substance were seen round the bronchi and bronchioles, and there was an extension of this type of tissue round the terminal

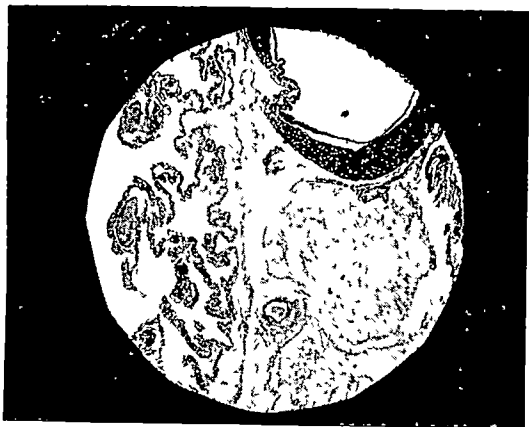


FIG 1—Adder lung showing adipose tissue round tracheal cartilage  
Photograph by N Morrison

alveoli and in the substance of the lung (see Fig 1). This appeared to me to be unusual, as one does not find adipose tissue in the lung of animals.

There is a possibility that for hibernative purposes Nature is capable of converting the interstitial tissues of the lung into adipose tissue. A good supply of fat ensures for the hibernating animal two things, namely

- (1) The possession of warmth for the organism
- (2) A reserve supply of energy when all other centres are exhausted

Fats are eminently suitable for the incalculably slow process of oxidation which goes on when respiration is almost suspended, during the process of hibernation. One can compare hibernation with a slow smouldering fire. It lasts as long as there is a combustible material. If that material is easily consumed, the fire will soon come to an end. If, on the other hand, the material is good fuel but burns slowly, the fire will keep going so long as Nature wants it. Fatty tissue serves Nature's purpose admirably in this direction, and my examination of the microscopic slides gave me the impression that the presence of so much fat in the pulmonary tissue was meant to give it the central control of hibernation. N MORRISON

### Behaviour in Invertebrates

A RECENT paper by Southern and Gardner<sup>1</sup> on the diurnal migrations of the Crustacea of the plankton in Lough Derg shows once more that observations by different workers on the behaviour of the same species of plankton animals are in many cases not in agreement. I have previously shown<sup>2</sup> that the copepod *Calanus finmarchicus* apparently behaves differently at one time of the year from another, this difference is, in a way, only *apparent*, as we are comparing individuals that are not strictly compar-

able, namely, *different broods* which have grown and developed under different conditions. If we compare the behaviour of similar broods from year to year, they appear to be the same. Is not this a side of the problem that has been rather overlooked in the past?

In comparing the behaviour of short-lived species from place to place, the comparison must be made between comparable broods that have developed under the same conditions. I have recently been able to show that there are possibly five distinct broods of *Sagitta elegans* during the year in the waters of the English Channel off Plymouth. Each of these broods is born and develops under different conditions brought about by seasonal changes. It is only natural to expect, therefore, that the individuals of each brood will have their own type of behaviour and seek optimum conditions that are different for those of other broods. F S RUSSELL

Marine Biological Association,  
Plymouth, Feb 17

<sup>1</sup> Southern, R., and Gardner, A. C., *Proc Roy Irish Acad*, vol 40, section B, No 11, pp 121-159, 1932

<sup>2</sup> *J Mar Biol Assoc*, N S, vol 15, No 2, pp 429-454, 1928

### Plato and the Modern Age

MR. W. G. LINN CASS, in his review of Mr. Lowes Dickinson's "After Two Thousand Years", remarks<sup>1</sup> that

"The extraordinary increase in scientific knowledge has vastly extended the realm of thought and revealed heights and depths which almost make the mind reel in contemplation of the physical universe"

And again

"turning to the thinker himself we find that he, for his part, has to spend so much time merely in the acquisition of knowledge, of which a certain minimum is essential, that he has little real leisure for serious meditation on the majestic but increasingly mysterious panorama of life which now unfolds before him"

These propositions seem to me to confuse the thinker with his telescope and even to suggest that it assembled its own parts. As a mere question of fact there is nothing 'reeling' in the mind of Sir James Jeans, for example, and no conspicuous lack of leisure for comparatively serious meditation in the many readers and listeners-in before whom he has displayed some of the mysteries of the universe. But is there not a deeper fallacy? Does the increase in scientific knowledge and the increasingly mysterious panorama of life really affect the mind of man in the sense indicated by Mr Linn Cass? If there were not this increase, the mind would decline in power. Its vigour is maintained at the same high level by the constant addition to the material of knowledge. The Hebrew star-gazer, who never held a telescope in his hand, wrote of 'the stars in their courses' with an astonishment not less than that of the astronomer of to-day. "We begin to see how insignificant our home in space really is", says the latter on page 117 of his book of that name, and the former said "When I consider . . . the stars, What is man, that thou art mindful of him?" Five billion years hence (if that is the correct figure) the new astronomer may be saying it again, and, haply, he will still refuse to be defeated by the contemplation of the physical universe, and will still contrive a foundation of faith on which to build his seat of knowledge among the stars. LAURIE MAGNUS

34 Cambridge Square, W 2,  
March 15

<sup>1</sup> NATURE, 129, 381, March 12, 1932

## Research Items

**Inheritance of Mental Defect**—Mental deficiency, its causes and inheritance, has recently been discussed by Prof F A E Crew (*Eug Rev*, vol 23, No 4), who points out the well-known difficulty in defining accurately, from a biological, psychological, or even legal, point of view, the various types of mental aberration. Idiocy, imbecility, and mental deficiency are not a biological classification of types, nor are the grades of mental defect genetically classified by drawing the line of normality at a particular intelligence quotient. In many instances, hereditary transmission is operating, but there are different genetic types of mental defect. In certain cases, amentia appears to be a single recessive genic character. This type should show a higher incidence in cousin marriages. Other pedigrees show ordinary dominance of the inherited mental defect with a high incidence in the family. In other cases, the method of inheritance requires an explanation by sex-linkage or multiple recessive factors, or a dominant gene together with a dominant inhibitor. The nature of the defect will also differ in families, because any abnormality of the brain may result in a mentally deficient condition. References are also made to primary and secondary ('acquired') amentia and to the influence of the uterine environment and order of birth in amentia and Mongolism.

**Iroquoian Origins**—Dr W D Lighthall has communicated to the Royal Society of Canada (*Trans Roy Soc Canada*, series B, vol 25, sect 2) a study of the affinities of the culture of the Iroquois, in which he arrives at the conclusion that the Iroquois were intrusive in North America, reaching it from South America by way of the West Indies, and that ultimately the stock was of Melanesian origin. It is pointed out that the early situation of the southern Iroquois was largely within reach of the Atlantic by way of rivers, and precludes all theory of a south-western or Mound Builder origin. Their distribution points to a derivation from the West Indies, where Arawak and the later Carib culture presents affinities to the great Guarani stock of South America. Points in Carib culture to which attention is directed with regard to the Iroquois are the organisation of the people of Guiana into five closely allied tribes or nations each with its own council, the construction of their towns on rivers or lakes, absence of domestic animals and dependence on hunting, the use of arrow and blowpipe, type of canoe, the election and position of the chief, and descent in the female line. It is pointed out, further, that the Iroquois are of a tropical and islander character. In the use of a raised bed-platform, blow-gun and bow, the hammock, the double-headed maize pestle, the elaborate body-painting and tattooing, incised patterns on their pottery, and their long houses, they show resemblances to the Guarani. As regards Melanesia, attention is directed to the resemblances which Dr Rivet has found between Melanesian skulls and certain ancient American types, while Prof Dixon has pointed out the peculiar and primitive type of the long-headed Iroquois skulls. The tattooing and pottery ornament are held to be of Melanesian, and possibly ultimately of African, origin.

**Articulation of Joints in the Bat**—A photograph accompanying a note by Mr J H Vickers in the *Field* for Feb 20 (p 264) affords a correction and explanation of an error which is constantly repeated even in works of unexceptionable scientific authority—that the knee in bats is so rotated outwards by the

wing-membrane that it is directed backwards like the elbow. The illustration referred to represents a long-eared bat crawling in the upside-down position, with the left leg flexed at the knee and ankle in the same way as it would be by any other plantigrade mammal, although the foot is merely turned outwards and not forwards, the right leg is stretched out straight, with the toes pointing backwards and the knee upwards, which gives the elbow-like effect. The fact is that the freedom of action in the hip and ankle-joints in the bat is so great that the leg has more than the play of the human arm, and functions as an arm to such an extent that it is easy to see how the idea of the reversion of the knee-joint gained currency, especially as the bat can crawl in any direction, and is rarely seen on the flat in the quadrupedal position, though some illustrations show it thus, the pose of the hind limbs being merely an exaggeration of the straddle of the squirrel's.

**The Grass Embryo**—Dr Lucy Boyd (*Trans and Proc Bot Soc Edinburgh*, vol 30, part 4, pp 286-303) has raised again the controversial question of the homologies of the parts of the grass embryo, putting forward the view that the coleoptile is the first plumular leaf, whilst the epiblast is part of a vestigial ligule of the cotyledon, the opposite side of which is fused with the scutellum. Her views appear to have originated mainly from a consideration of evolutionary trends in Monocotyledons, the interpretations so suggested being supplemented by anatomical investigation. The series of types selected to illustrate the gradual reduction of the cotyledonary ligule to the final condition existent in the Gramineae is well chosen and suggestive. The evidence for the foliar nature of the coleoptile is less convincing. It is true that the derivation of the vascular supply to the coleoptile from the scutellum does not eliminate this interpretation, but, on the other hand, the same facts would apply if the coleoptile were regarded as part of the much modified cotyledon. Further facts are required before an agreement on this much-discussed question is likely to be general. It seems probable that a detailed comparison of the embryos from the earliest stages of development is most likely to give facts which may lead ultimately to a satisfactory interpretation.

**Permian of Texas**—The Permian System in Trans-Pecos Texas shows a more complete development than in any other part of North America, and is regarded by R E Evans (*Geology of the Glass Mountains*, Texas, part 2, *Univ Texas Bull*, 3042, 1930, pp 245, pls 44) as one of the standard sections of the Permian rocks of the world, comparable with the sections in the Salt Range of India, the island of Timor, and the Urals. In Texas the most complete Permian section is in the Glass Mountains, north of Marathon, where the system is represented by 7000 feet of strata divisible into six formations. A summary of the stratigraphy and palaeontology is given, but the main part of the work is devoted to a description of the brachiopods, of which 185 species and varieties, belonging to 47 genera, are recognised. These belong mainly to the Protremata and Telotre-mata, the Atremata are not represented, and only two forms of the Neotremata were found. The presence of the families Richthofenidae and Lyttonidae, and the abundance of the Productidae, are the most striking features in the brachiopod fauna.

**Pleistocene Climates of North China**—Prof G B Barbour has published a valuable paper on this



subject (*Bull. Geol. Soc. China*, vol. 10, pp. 71-104 (Grabau Anniversary Volume)). A brief description is given of fossiliferous continental deposits of late Pliocene and early Pleistocene age discovered near Taiku, Shansi. The contrast in character between the lower and upper members of the series points to a distinct change in conditions of weathering and throws new light on the climatic fluctuations. Three schemes of stage correlation with European stages are discussed, and the conclusion is reached that the facts are inexplicable without appeal to a shift of the earth's axis of rotation. The problems raised by each hypothesis are considered and directions suggested which may lead to a solution. Meanwhile it seems clear that the evidence is in close accord with Simpson's radiation control hypothesis, and that the warm climate inferred from the fossils and lithology of the Taiku beds supports the Wegener-Koppen hypothesis of polar shift. Dr. D. Black in a paper on "Palæogeography and Polar Shift" in the same journal (pp. 105-57) also adduces evidence favouring acceptance of the Simpson and Wegener-Koppen hypotheses. He writes: "The same set of hypothetical considerations as give adequate explanation of the extraordinarily varied Quaternary climatic conditions known to have obtained in North and South America, in Europe, Australia, Tasmania, and New Zealand, would seem in turn to yield equally satisfactory explanation for the peculiarly different climatic conditions characterising Asia during the same period." The paper is illustrated with twenty-six maps of the world representing the longitudes and latitudes corresponding to seven selected points on the assumed trajectory of the shifting pole.

**The Formation of Alto-cumulus Clouds.**—In a note on alto-cumulus cloud by C. S. Durst in the *Meteorological Magazine* for January 1932, new light appears to be thrown on the physical processes involved in the formation and maintenance of this type of cloud. Mr. Durst was led to consider the probable origin of the instability necessary for the formation of such convectional clouds with their bases at a great height above the earth's surface. It seemed to him probable that a combination of loss of heat by radiation from the tops of the clouds and gain of heat at their bases by radiation from the earth and the atmosphere below the clouds, might yield the simplest explanation. But there is the difficulty that alto-cumulus should according to this hypothesis be more frequent at night than by day, because of the considerable insolation usually taking place on the upper surface of the cloud during the day, which appears to be flatly contradicted by Russell's observations on the diurnal variation of frequency of these clouds in southern England. Durst has, however, found that Russell's figures, showing a marked minimum around 1 A.M. and 2 A.M., are greatly affected by the frequent difficulty of seeing alto-cumulus at night when it is present. When due allowance is made for this, it appears that the frequency at night is in all probability between two and four times as great as it is by day.

**Absorption of Hard  $\gamma$ -Radiation.**—Two exceedingly careful studies on the absorption of  $\gamma$ -rays are reported in the February number of the *Proceedings of the Royal Society*. One by C. Y. Chao is concerned with the variation with wave-length of the absorption in lead. It establishes that there are abrupt changes at about 6 X.U., the absorption passing through a minimum value, and the conclusion is drawn that this is connected with the existence of an excitation or disintegration potential for the lead nucleus. The other, by G. T. P. Tarrant, deals with the variation with atomic number of the absorption coefficient for

the monochromatic  $\gamma$ -rays from one of the members of the thorium family of elements. The curves expressing the results are more regular and comprehensive than those of earlier investigators, and agree with the best of these. For the light elements the absorption coefficients appear to be a little greater than would be expected from the theory of Klein and Nishina, but the origin of the discrepancy is not certain. For the heavy elements there is definitely extra absorption, and it seems now to be generally agreed that this represents in part a nuclear phenomenon, although the nature of this is not indicated so clearly by Tarrant's work as by Chao's.

**Cathode-ray Oscillographs.**—The importance of the cathode-ray tube as an instrument for measuring electrical quantities is a good example of the assistance that pure physics is constantly giving to electrical engineering. It also shows that unless the principles underlying the operation of the apparatus are clearly understood, erroneous conclusions may be drawn from its readings. At the Institution of Electrical Engineers on Feb. 5, two papers were read on these instruments. The first, by Dr. A. B. Wood, dealt briefly with some of the more important developments in their design and use. He considers that, of the various methods for focusing the cathode stream, the electrostatic method gives the best results. The recording of the effects of lightning is a difficult matter, owing to the uncertainty in the time of the arrival of the impulse. The timing in this case has to be automatic, the lightning impulse itself initiating the time deflexion of the cathode-ray spot. The second paper, by Prof. MacGregor-Morris and H. Wright, discusses possible sources of error in using these instruments for measuring purposes. Modern tubes have seldom serious faults due to defects in manufacture. The authors discuss the supposed 'threshold' effect. This effect, as generally stated, is that a definite value of the deflecting voltage has to be reached before any deflexion takes place. Their results show that this is only approximately true, as the sensitivity, although it is smaller, is not zero for small deflecting forces. For electromagnetic deflexions, no such effect was observed. Stress is laid on the necessity of calibrating the tube accurately. This should be done photographically, and should be carried out over the greater part of the surface of the fluorescent screen and not merely for two lines at right-angles to one another.

**The Determination of Nitrogen Peroxide.**—E. J. B. Willey and S. G. Foord have described a new and rapid method for the determination of nitrogen peroxide (*Proc. Roy. Soc.*, Feb.). White light from a constant source is filtered to give a narrow band of wave-lengths, then passed through an absorption tube holding the mixture to be analysed, and finally received on a photoelectric cell. From the current passed by the cell, which is measured by a Wynn-Williams valve bridge, the intensity of the light falling on the cell, and hence the amount of absorption by the peroxide, are determined, and from a preliminary calibration with known amounts of peroxide the amount of this present is then known. The device may be used for concentrations of  $1 \times 10^5$  and upwards. It has a number of interesting uses, including the regulation of temperature and pressure by a thermostatic control actuated by a variation in current through the cell caused by a shift in the equilibrium between the simple molecule ( $\text{NO}_2$ ), which is transparent, and the coloured polymer ( $\text{N}_2\text{O}_4$ ).

**Optical Activity in Diazo-Compounds.**—Although optically active diazo esters containing only one

possible asymmetric carbon atom bound to the diazo group have been prepared, their specific rotations are small, and compounds with large rotations previously obtained contain another asymmetric carbon atom and are very unstable. Suggestions have been made that the diazo esters have a ring structure. Ray (*J. Amer. Chem. Soc.*, Jan.) has now prepared a stable, optically active, crystalline aliphatic diazo-compound,  $\beta$ -naphthol-phenyldiazomethane, melting at  $120^\circ$  and having a high specific rotation, which shows that a carbon atom attached to the diazo group may retain its asymmetry. The compound was prepared from the active forms of the amine,  $\beta$ -naphthol-phenylaminomethane, by dissolving this in pyridine and, after addition of sodium nitrite, adding to cooled concentrated hydrochloric acid, when the diazo compound separated in light flaky lemon-yellow crystals. Its formula is decided by the fact that treatment with alkali does not racemise the compound, so that the diazo group and carbon atom are in a straight chain, the pentad nitrogen losing an electron to the carbon, to which it is otherwise united by an electron pair.

**Preservation of Railway Sleepers**—In *Forest Bulletin* No. 74 (Economic Series), 1931, Mr. F. J. Popham summarises the results of laying treated experimental sleepers in the various railway systems of India. The author states that it is now recognised that the open tank treatment given in the majority of the earlier tests is inadequate, and that treatment in a pressure plant, with the specification worked out

for each species, will give better results. Apart from one or two instances in which the iron pot sleeper was made use of, most of the premier Indian Railway main lines, when their first construction was undertaken during the 'sixties and 'seventies of last century, made use of either deodar, teak, or sal, the three chief timbers in common use in the country. The investigations into treated sleepers are concerned with other Indian timbers and the experiments here dealt with are confined to the five species *Pinus longifolia*, *Pinus excelsa*, *Dipterocarpus tuberculatus*, *Dipterocarpus alatus*, and *Terminalia tormentosa*. The preservatives used were carbolineum avenarius, zinc chloride and carbolineum avenarius, Powell's solution, and solignum and earth oil. So far the dipterocarps have been failures, whilst Powell's solution appears unsuitable in damp conditions, being subject to leaching. As was to be expected, certain anomalies have become apparent in the different tests, which further investigations will probably elucidate. An examination of the results in the Karachi division is of interest. The sleepers (the two pines and *Terminalia*) were Powellised and laid down in the main line in 1911. They were removed from the line in 1922, many of them suffering from rot. The best of these were selected and relaid in Palidan's goods yard in 1922 and have given excellent service since. In all probability they would have been removed from the main line by now owing to mechanical failure, but their life indicates their durability, so far as white ant and fungus attacks are concerned, when placed in a dry area.

### Astronomical Topics

**Conjunction of Venus and Mars in AD 864**—*NATURE* for Nov. 28, 1931, contained an article by Mr. J. H. Reynolds in which mention was made of an observation made by Habash at Baghdad of an extremely close conjunction of the above planets, the date is given by Mr. Reynolds as Oct. 10, but calculation by Dr. A. C. D. Crommelin shows that it should be Oct. 21 astronomically reckoned, or the morning of Oct. 22 civil. The calculation was made for Oct. 21 64 G.M.T., which is the time of sunrise at Baghdad, the accelerations adopted by Dr. Fotheringham and Herr Schoch were applied to Newcomb's tables, the centennial values are  $2.472''$ ,  $1.521''$ , and  $0.8087''$  for Venus, earth, and Mars respectively. The conjunction in longitude occurred about twelve minutes after sunrise, Mars being  $104''$  north of Venus. It would have been more than an hour after sunrise if the accelerations had not been applied, hence the phenomenon gives support to the accelerations. Mars was 2.22 units from the earth, hence it would be rather faint, and would probably not be visible later than twenty minutes before sunrise, at which time the distance between the planets would be about  $2'$ . The distance between the components of the 'double-double' epsilon Lyrae is  $3\frac{1}{2}''$ , and it needs an acute eye to divide it, it is doubtful whether any eye could separate Venus and Mars at a distance of  $2'$ , the calculation vindicates the accuracy of Habash's statement that they came so close as to appear one planet.

**The Orbit of 61 Cygni**—The *Observatory* for February contains a letter from Mr. A. Fletcher on the subject of the orbit that he has lately calculated for this star. The difficulty in this case is to determine the inclination of the orbit-plane to the line of sight, owing to the shortness of the arc covered by good observations, compared with the whole orbit. Since the parallax is very well known (Prof. Schlesinger adopts  $0.300'' \pm 0.003''$ ) and the absolute magnitudes

are thereby determined, Mr. Fletcher derives the masses from the mass-luminosity law, this gives the inclination, and the other elements follow. Their values are given in *Monthly Notices* of the Royal Astronomical Society for December as follows: Period 696.63 years, periastron passage 1686.37,  $a$   $24.525''$ ,  $e$   $0.40369$ ,  $i$   $+52.896^\circ$ ,  $\omega$   $153.917^\circ$ ,  $\Omega$   $172.823^\circ$ .

Peters' orbit, published in *Astr. Nach.* in 1887, gave the period as 783 years from a much shorter arc, so there is good reason for hoping that the new period may be in the neighbourhood of the truth.

**Report of the Naval Observatory, Washington, for 1931**—The six-inch transit circle was in use for observation of the sun, moon, planets, and fundamental stars, also for the Eros-comparison stars; Eros itself was observed 28 times on the meridian. A Shortt clock was received in November 1930, and was in use for most of 1931. Its rate was steady; there is a temperature variation of 0.07 sec. per day per degree centigrade, but as the temperature is kept very nearly constant, this is not important. A new clock vault will contain piers for seven clocks. With the 26-inch equatorial, Eros was observed 101 times, the satellites of Saturn on 28 nights. Sixty-five photographs of Eros were obtained with the 12-inch equatorial, using a yellow screen, as the objective is a visual one. Stars of magnitude 10 need an exposure of one minute; those of magnitude 14 need an hour. The sun was photographed on 303 days with the photoheliograph, spot activity continues to decrease, and the minimum is expected in 1933 or 1934.

In the Nautical Section it is noted that instruments have been constructed that give a continuous record of the direction of a ship's course as determined by the gyrocompass, with an accuracy of one-tenth of a degree, also instruments for giving a dead-reckoning position of the ship.

## International Atomic Weights\*

TWO changes in the table of atomic weights are recommended by the Committee on Atomic Weights of the International Union of Chemistry in its second report, which has just been published, the atomic weight of krypton is considered to be 83.7 instead of 82.9, and of xenon 131.3 instead of 130.2. The Committee, which consists of Prof G P Baxter (Cambridge, Mass.), Mme P Curie (Paris), Prof P Lebeau (Paris), and Prof R J Meyer (Berlin), reports on all the atomic weight investigations published during the period Feb–Oct 1931 which have come to its attention, future reports will cover a period of twelve months. Authors of papers bearing on the subject are requested to send copies to each of the five members of the Committee at the earliest possible moment.

Elements of which the atomic weight has been determined during the period under review by physico-chemical methods are nitrogen, carbon, sulphur, fluorine, krypton, and xenon, chemical methods have been applied to the study of nitrogen, silver, chlorine, and iodine, physical (mass-spectrograph) measurements have been applied to the calculation of values for lithium, caesium, boron, germanium, selenium, tellurium, tungsten, bromine, rhenium, ruthenium, and osmium, whilst a new determination of the relative proportions of the oxygen isotopes has been made by microphotometric evaluation of the band spectrum of oxygen.

Reference should first be made to the investigation last mentioned, because the results provide a new conversion factor for the calculation of 'chemical' atomic weights from 'physical' atomic weights, and emphasise the disparity between the two scales for the determination of atomic weights used respectively by chemists and by physicists. This "undesirable situation" arises from the fact that the chemical unit,  $O=16$ , takes no account of the existence of the three isotopes of oxygen,  $O^{16}$ ,  $O^{17}$ , and  $O^{18}$ , present, according to Mecke and Childs, in the ratio  $630 \pm 20 : 1 : 0.2$ . The physical unit is referred to the isotope  $O^{16}$ , and hence the two scales differ by one or two parts in ten thousand. The propriety of employing hydrogen, helium, or  $O^{16}$  as a chemical standard has therefore been canvassed, but in Dr F W Aston's opinion, communicated to the British Association last year, the present chemical standard amply satisfies all requirements of international atomic weights so far

as accuracy is concerned. The Committee agrees unanimously with Dr Aston, and therefore does not propose a departure from the existing unit. The new conversion factor is 1.00022, whilst the Naudé factor, at present in use, is 1.000125.

Nitrous oxide has been found by Batuecas to have a normal density of  $1.98042 \pm 0.00005$  (not 1.98038 as given in the original), this value being the mean of twenty determinations. Cooper and Maass report values of 44.0054 and 64.059 for the molecular weight of carbon dioxide and sulphur dioxide respectively, leading to atomic weights of 12.0054 for carbon and 32.059 for sulphur. Patterson, Whytlaw-Gray, and Cawood, repeating the work of Moles and Batuecas, find the molecular weight of methyl fluoride to be 34.046, and are of opinion that the true atomic weight of fluorine lies nearer to 19.010 than to 19.000 (see NATURE, 128, 375), despite Aston's view that fluorine is a simple element. By comparison of the densities of krypton and oxygen, Watson calculates the atomic weight of krypton to be 83.71, whilst Whytlaw-Gray, Patterson, and Cawood, by comparison of the pressures at which xenon and oxygen possess the same density, find the atomic weight of xenon to be  $131.26 \pm 0.005$ .

Gravimetric determination of the ratio  $Ag : NH_3$  by Baxter and Greene, combined with the ratio  $Ag : NO_3$ , gives, when chloride or dilute bromide solutions are used, the value 14.0078 for the atomic weight of nitrogen. Honigschmid corrects the results of silver chloride analyses by Honigschmid and Bedr Chan, and obtains a mean atomic weight for chlorine of 35.456<sub>3</sub> (gravimetric) or 35.456<sub>7</sub> (nephelometric). Thermal decomposition of iodine pentoxide, employed by Baxter and Butler, leads to the low value  $I=126.905$ , and the method is considered to be insufficiently precise. Combination of the ratios  $2Ag : I_2O_5$  and  $I_2 : I_2O_5$  affords the value 126.929. Determinations of the ratio  $AgI : AgCl$  by Honigschmid and Striebel give the low value 126.917 ( $Cl=35.457$ ). Aston's value, 126.932 ( $O^{16}=16$ ), corresponds with a chemical atomic weight of 126.918 or 126.905, according to the conversion factor employed, but is a mean of observed limiting values 126.907 and 126.957.

Calculation of atomic weights from mass spectra, using Naudé's equation, leads to the following results ( $O=16$ ): lithium 6.923, caesium 132.91, boron 10.806, germanium 72.65, selenium 78.96, tellurium 128.03, tungsten 183.96, bromine 79.916, rhenium 186.22, ruthenium, 101.1, osmium 190.31.

\* Union Internationale de Chimie. Table internationale des poids atomiques. Deuxième rapport de la Commission des poids atomiques, 1932. (Paris: U I de C, 49 Rue des Mathurins.)

## Co-operation in Fisheries Investigations\*

THE twenty-fourth annual meeting of the International Council for the Exploration of the Sea was held in Copenhagen in March 1931. During the short interval of nine months between this meeting and the last, the general lines of work and instructions laid down by the Council have been followed. Three special conferences took place during the year, the first and second at Lowestoft, on the transplantation of plaice and on herring investigations, the third at Lisbon, on the sardine fisheries.

In reviewing the general work already accomplished, it is shown that striking progress has been

made in the 'technique' of prognostication of the fisheries. In the administrative report of the Committee of the Northern North Sea, the chairman is able to state with regard to the haddock that the work has reached the stage where the yield of the North Sea haddock fisheries for eighteen months or two years ahead can be anticipated with great accuracy. The report of the Southern North Sea Committee records, not for the first time, a successful forecast of the East Anglian herring fishery, and the report of the North and Western Area Committee records the complete justification of a forecast made in the previous year of the trend of the Icelandic cod fishery.

Extensive cod-marking experiments are being carried out by Denmark in Greenland and Iceland and show an interchange between cod populations

\* Report of British Delegates of the Meeting of the International Council for the Exploration of the Sea, held at Copenhagen, March 23–28, 1931. Drawn up by Henry G. Maurice and D'Arcy W. Thompson. Pp. 9. (London: Ministry of Agriculture, 1931.)

of Davis Straits and Iceland, the cod populations of Iceland being thought previously to be self-contained.

This year is the second International Polar Year, when polar hydrographical conditions will be specially investigated by all nations. It is hoped that intensive observations will be made of internal waves in the Southern Cattegat during a period of seven days in August. The English hydrographic programme includes an extension of the total current measurements which have been carried out at the Varne Lightship in the past.

The question as to whether the Limnological and the Plankton Committees should remain as separate entities was discussed, and it was decided to reconsider this at the next meeting.

Special scientific meetings on plankton and hydrology dealt with the conditions of plant life in the sea. Prof. Gran, as chairman of the Plankton Committee, reviewed recent work on the effects of phosphates and nitrates on the growth of plankton. From his own work he inclines to the belief that manganese and iron derived from coastal waters are necessary, in addition to phosphates and nitrates, for planktonic growth in Atlantic waters.

Dr Henry Bigelow, of Woods Hole Oceanographical Institution, attended the meeting as a visitor and outlined plans for future work in the North Atlantic in which the North American Council on Fisheries Investigations might co-operate with the International Council. The Council expressed appreciation of the work to be carried out on the western side of the Atlantic, and declared that the moment is opportune to enter into close co-operation with both the Woods Hole Institution and the North American Council of Fisheries Investigations, and that this can best be achieved by close personal touch between the workers. The Council invite representatives of both bodies to take part regularly in its deliberations, in order to arrive at unity of plan and methods in the study of those fundamental problems which are similar or identical on both sides of the Atlantic.

The conclusions of the delegates are that the organisation is on a thoroughly sound footing, that its reputation in the scientific world has grown and continues to grow, that the welfare of the fishing industry demands the continuance of scientific investigations, and that the Council should be encouraged to continue its useful work.

### Forestry in Trinidad and Tobago \*

THE keynote of the Annual Report of the Forest Department of Trinidad and Tobago (Trinidad, May 1931) is to be found in the opening paragraph on "Forest Resources." The conservator, Mr R. C. Marshall, is able to write "As a result of a considerable amount of detailed field work during the last few years, we are now in a position, in regard to a considerable area of forest, to be able to substitute a clear picture of the stand of timber for the vague general idea with which, in the past, we have had to be content." Unfortunately, in far too large a proportion of the Empire forest departments this vague general idea of the forest resources still persists. The survey of the forests in Trinidad is being effected by the well-known method of running lines in carefully considered directions 100 chains apart and enumerating the trees on the lines, thus obtaining a one per cent enumeration, 6000 chains of lines were run in 1929 and 5600 in 1930.

From the enumeration surveys already made, it is now established that the Colony's 600,000 acres of forest contain a very large amount of wood. This is supported by the stock-taking effected on 1000 acres of mora (*Dimorphandra mora*) in Mayaro, and on 1000 acres of mixed forest in the Central Range Reserve, in which crappo (*Carapa guianensis*) and guatecare (*Lecythus laevifolia*) form the most plentiful of the useful species. Appendix D gives the data of the species found on these two areas and is of great interest. It has established the fact that the mora forest in its constitution is far more comparable with the pure forests of temperate regions, which provide the bulk of the timber of commerce. It is considered possible, therefore, that this type of forest gives possibilities of regulated commercial working or 'lumbering' in the Colony. These two types of forest are representative of a large proportion of the forests of the Colony. "Increased utilisation of our forest resources", writes the Conservator, "hinges mostly on getting together stocks of timber and seasoning them properly." In view of the fact that the Colony imported £233,000 of forest produce during the year,

this rightly forms one of the problems which is receiving the closest consideration.

The two most popular woods in the Colony are said to be cedar (*Cedrus mexicana*) and balata (*Mimusops balata* var. *Cruegeri*). The enumeration surveys have shown the very small proportion which these species bear to the total crop, and that the younger age classes are very deficient. It is with satisfaction that we read that working plans are being prepared, and that in the case of cedar they prescribe and control the yield. Other plans are in course of preparation, one for the control of the mangrove swamps close to Port of Spain, which are a very important source of fuel wood for the city.

The Report is replete with details of progress which will have a far-reaching effect on the prosperity of the Colony. Mention can only be made of interesting silvicultural experiments and sowing and planting work, of investigations in connexion with forest soils in collaboration with Prof. Hardy, of the Soil Department of the Imperial College of Tropical Agriculture, and finally, in collaboration with the Trinidad Government Railway, a beginning has been made with wood preservation experiments in connexion with the treatment of mora sleepers. The administrators of the Colony are to be congratulated on the marked progress which their Forest Department has achieved in the past few years.

In Leaflet No. 4 of the Forest Department, Mr R. C. Marshall deals with the "Forest Trees of Trinidad and Tobago, with Special Reference to their Timbers". The leaflet gives a reasonably complete list of the more prominent forest trees, stating the size to which various species grow, their relative abundance, and giving in a concise form some information as to the timber they produce. It is not, nor does it purport to be, a complete list of all forest tree species. As noted above, there are 600,000 acres of forest in the Colony. With the exception of the mora forests, which are of special interest through the gregarious habit of mora and the large stocking per acre, practically all the remainder is of a very mixed type such as is common in tropical rain forest, to which category most of the forests belong. Two tabular statements are attached which show the trees by one foot girth

\* Trinidad and Tobago Forest Department Administration Report of the Conservator for the Year 1930. Pp. 22. (Trinidad Government Printing Office, Port of Spain, 1931.) 1s

classes, enumerated on 1000 acres of each type, these tables give some idea of the large number of species which constitute the mixed type of rain forest as compared with the mora forest

In Leaflet No 3 of the same Department a note has been drawn up by Mr R L Brooks, deputy conservator of forests, on "An Experiment on Air Seasoning of Native Timbers" Experiments with

some of the native woods have been carried out under the supervision of Mr Brooks, and so far as they have gone apparently justify the hopes of ultimate success The imports of lumber into the Colony are high, and Mr Brooks is definitely of opinion that they could be considerably reduced if stocks of seasoned local timber were made available

### Electrical Heresies

IN *Stanford University Publications*, University Series, Mathematics and Astronomy, vol 2, No 1, Fernando Sanford, emeritus professor of physics, discusses terrestrial electricity and related topics The volume, of 208 pages, is well produced and interestingly written; but it would form a very unsafe guide to knowledge The author propounds views that he recognises as being very heretical, and bound to meet with a hostile reception, but it would be mistaken to be disarmed by his candour in this respect His cardinal heresy is that "absolute electrical neutrality is unknown upon the earth, and could not be recognised if it were observed" (p 71)

Prof Sanford supposes that the ratio of the numbers of protons and electrons may be variable within wide limits upon different planets In particular, he believes that the sun and earth possess large negative charges—large enough, in the case of the earth, to explain the magnetic field as a result of the daily rotation of the charge He is aware of the familiar argument—simplest in the case of the sun—that the charge would be expelled by mutual repulsion and the outflow of electrons from the ionised solar atmosphere, but he denies that the electric charge upon a conductor exerts an outward pull upon the atoms of the conductor (though the experiment of an expanding charged soap-bubble would seem to indicate that they do), and that free electrons are held to the sun

by gravitation alone He asserts that electrons are apparently held to conductors by the pressure of the surrounding ether, which can sustain very great charges upon bodies His positive arguments for the existence of a large solar charge are based on the supposed necessity for considerable charge-densities to explain the magnetism of sunspots, and also of the sun as a whole, also upon the electron gas theory of the solar corona, and on the supposed electrical repulsion of comets' tails—all of them being highly debatable matters, certainly not yet explained according to the generally accepted laws, but very unsuitable as foundations for a striking break-away from these laws

Further, Prof Sanford suggests that electrical repulsions between the sun and planets may produce planetary perturbations (particularly for Mercury), and that the daily variation of the charge induced upon the earth by the sun can be detected His interpretation of his observations on this point is unlikely to gain favour, but the observations themselves might usefully be checked by other observers Later chapters of the book deal with the electrostatic field of the earth, earth-currents and magnetic variations, magnetic storms and solar activity, magnetic and electric influence of the moon, and barometric pressure and the earth's electric charge; to the reviewer they appear to abound with unlikely hypotheses

### International Congress of Prehistoric and Protohistoric Sciences

A PRELIMINARY outline of the arrangements for the First International Congress of Prehistoric and Protohistoric Sciences, which is to be held in London, has been issued, and it is announced that in order to meet the convenience of foreign delegates the date of meeting will be Aug 1-6, instead of July 25-30, originally arranged The first meeting will be held on the afternoon of Aug 1, and formal meetings will be continued during the week The following week will be devoted to excursions to places of archaeological interest The Congress will meet under the presidency of Sir Charles Peers, Mr R Holland-Martin will act as treasurer, and the general secretaries are Prof A W Brøgger and Prof J L Myres These appointments were made at the first meeting of the permanent council held in Paris in October last

In accordance with a further decision of the permanent council, the work of the Congress will be divided into sections, arranged according to practical requirements rather than on strictly scientific lines A classification of subject matter has been made for the first Congress, on the understanding that future division will be considered at the Congress The following is the list of sections, with the names of the British archaeologists who have been invited to act as presidents Human Palæontology, the Origin and Evolution of Prehistoric Man (Sir Arthur Smith Woodward), Palæolithic and Mesolithic Periods (Mr Reginald Smith), The Neolithic, Bronze, and Iron Ages in the Ancient World (Prof H J

Fleure, Prof J L Myres, Mr Sydney Smith), The Neolithic, Bronze, and Iron Ages outside the Ancient World (Dr H S Harrison and Prof C G Seligman), The Passage from Prehistory to History (Mr E T Leeds)

A number of questions has been placed on the agenda, although it is understood that communications on other matters may be offered, provided they come within the limits imposed by the statutes Among the subjects specifically mentioned are the present state of our knowledge of fossil man, discoveries of human industries in the drift and the loess, the mesolithic question, the megalithic monuments, the problems of the copper and early bronze ages in western Europe, the origin of Mediterranean civilisations, the oriental basis of Ægean chronology, Mediterranean contacts of the west European cultures of late bronze age and Hallstatt types, the Continental sources of racial and industrial types among the Anglo-Saxons, the origin and chronology of the Viking movements Communications must be sent to the Secretary of the British Organising Committee, Society of Antiquaries, Burlington House, Piccadilly, London, W 1, before May 1, 1932

Excursions have been arranged, to follow the Congress They begin on Aug 6, when those joining will be divided into two parties, of which one will stay at Oxford until Aug 9, visiting the Rollright Stones, Wayland's Smithy, Uffington, etc, as well as the Ashmolean and Pitt-Rivers Museums The second party will stay at Cambridge until Aug 9,

visiting Ipswich, Bramford, and Ely on one of the intervening days, and then proceeding to Oxford, where, after this party has inspected the Ashmolean and Pitt-Rivers Museums, the two parties will join to visit Salisbury and Devizes, returning to London on Aug 11. An extended excursion, to take in the west of England, and lasting from Aug 11 until Aug 15, will be arranged for those who desire, or as alternatives, arrangements will be made for a visit to Ireland, to include Tara, New Grange, and Monasterboice, or to Scotland, to include inspection of the Scottish National Museum and prehistoric sites in the neighbourhood of Edinburgh.

The subscription to the Congress is £1 for members and 10s for associates. Subscriptions should be sent to the treasurer of the Congress, at the Society of Antiquaries, Burlington House, Piccadilly, London, W.

### University and Educational Intelligence

CAMBRIDGE —The following grants have been made from the Worts Fund: £65 to L. S. B. Leakey (St John's College) for the continuation of archaeological and anthropological work in East Africa, £50 to A. Stephenson (St Catharine's College) towards the expense of publication of the results of the British Arctic Air Route Expedition, £30 to R. B. Roberts (Emmanuel College) and W. V. Lewis (Gonville and Caius College) for cartographical work in Iceland, £30 to R. M. Jackson (St John's College) towards the expenses of a geographical expedition to Spitsbergen, £25 to E. H. F. Baldwin (St John's College) for biochemical research at Tamaris, £25 each to P. W. Richards (Trinity College) and P. M. Synge (Corpus Christi College) for botanical research in Sarawak, £20 to S. R. Nockolds (Trinity College) for geological research at Carlingford.

The following have been elected to fellowships at King's College: Mr L. Barstow, scholar, who was placed in Class I Part I 1927 and in Class I Part II 1928 of the natural sciences tripos, as S. H. Ehrman fellow, Dr H. C. Darby, scholar of St Catharine's College, University lecturer in the faculty of geography, who was placed in Class I Part I 1926 and in Class I Part II 1928 of the geographical tripos.

EDINBURGH —The Senate has resolved to offer the honorary degree of LL.D. to the following, among others: Prof C. Vernon Boys, Mr David Middleton Greig, Royal College of Surgeons, Edinburgh, Dr R. Stewart MacDougall, formerly reader and Steven lecturer in agricultural and forest entomology in the University of Edinburgh, His Excellency Andrew Mellon, United States Ambassador, London, Prof Arthur Robinson, emeritus professor of anatomy in the University of Edinburgh, the Right Hon. Sir Archibald Sinclair, Secretary of State for Scotland, and Sir Josiah Stamp.

LEEDS —Prof J. W. Harvey, at present professor of philosophy in the University of Durham (Armstrong College), has been appointed professor of philosophy, in succession to Prof C. M. Gillespie, who retires at the end of the present session. Prof Harvey was educated at Bootham School, York, at Rugby, and at Balliol College, Oxford. He took a first class in classical honour moderations in 1909 and a first class in the final Lit. Hum., 1911. He was lecturer in philosophy in the University of Birmingham from 1912 until 1927, when he was elected to the chair of philosophy at Armstrong College.

LIVERPOOL —At the meeting of Council on March 13 it was agreed to confer the honorary degrees of M. Eng. and M. Sc., on July 2, on Mr H. H. Harrison and Mr

W. Horton respectively. Mr Harrison has published works on steam turbines, boiler feed injectors, and the historical basis of modern telegraph printing. Mr Horton has been honorary lecturer in plant histology in the University during the past ten years, and has distinguished himself by his investigations on the technical methods of histology and, in particular, by his work on the preparation of knife edges and the critical angles in the sectioning of waxes.

Prof Herbert E. Roaf, professor of physiology in the London Medical School, has accepted the George Holt chair of physiology in the University as from Oct 1, in succession to Prof J. S. Macdonald, who retires at the end of the present session. Prof Roaf was in succession Johnston colonial fellow, assistant lecturer in physiology, and lecturer in chemical physiology in the University of Liverpool. From 1911 until 1920 he was lecturer in physiology at St Mary's Hospital Medical School, London.

PROF A. H. STURTEVANT, professor of genetics at the California Institute of Technology, will lecture at the University of Birmingham during the autumn term of this year. He will be in residence at the University of Leeds on Jan 5–March 18, 1933, and afterwards proceed to Armstrong College, Newcastle. The lectures have been arranged in connexion with the scheme of the Carnegie Endowment for Industrial Peace, by which certain American professors will spend a year visiting universities in Great Britain.

THE directors of higher education from a number of different countries have just met, for the first time, at the International Institute of Intellectual Co-operation for the purpose of discussing various questions of great importance in the organisation and functioning of their university systems. The following were present: M. Jacques Cavalier (France), M. Ugo Frascarelli (Italy), Sir Frank Heath (British Empire), Prof Zoltan de Magyary (Hungary), Prof Werner Richter (Germany), and Dr Horatio Krams (American University Union in Europe, observer). The committee drew up a comprehensive programme for future work, envisaging, more particularly, agreements concerning university exchanges and the overcrowding of universities and of the liberal professions.

THE Ministry of Agriculture and Fisheries is offering five senior scholarships tenable at agricultural colleges or university departments of agriculture for diploma or degree courses in an agricultural subject, and 130 junior scholarships (including 10 extended junior awards for those who have already held junior scholarships) tenable at farm institutes for courses in agriculture, horticulture, dairying, or poultry husbandry. The awards are confined to sons or daughters of agricultural workers and *bona fide* workers in agriculture. Forms of application and other information may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W. 1, or from the offices of county councils. The latest date for receiving applications is April 30.

A LIMITED number of fellowships are being offered by the Salters' Institute of Industrial Chemistry to chemists of post-graduate standing. The object of the fellowships is to afford additional and special training preparatory to a career in industrial chemistry. The normal value of each fellowship is from £250 to £300. The Institute also offers a limited number of grants-in-aid to young men or women, not under seventeen years of age, employed in chemical works in or near London, who desire to extend their education for a career in chemical industry. Applications for the fellowships and grants-in-aid must be sent not later than May 1 to the Director, Salters' Institute, Salters' Hall, St Swithun's Lane, E.C. 4.



## Calendar of Geographical Exploration

March 28, 1907 — A Tragic Journey in Greenland

L. Mylius-Erichsen, with Capts Koch and Hagen, an educated Eskimo, Bronlund, and two others, left their winter quarters in Danmarkhaven, Greenland, lat  $75^{\circ} 43' N$ . The expedition had set out in June 1906, and the ship remained at Danmarkhaven for two years, while systematic observations were kept up at the base and the work of exploring to the north was carried on by sledge. Mylius-Erichsen and his party reached the eastern extremity of Greenland,  $81^{\circ} 29' N$ , charting the coast as they went. There they divided, Koch and two others reached Cape Bridgman in  $83^{\circ} 29' N$ , thus linking up with Peary's 1900 expedition, and returned safely. Erichsen, with Hagen and Bronlund, followed the coast westward into the deep inlet now known as Danmark Fjord. Keeping to the coast, they entered Independence Bay and pushed on to Cape Glacier in  $82^{\circ} N$ ,  $35^{\circ} W$ , on June 14, 1907. Here they were held by the softness of the snow all summer, and then time was lost on a drifting floe in an effort to cross Danmark Fjord. The only chance of escape was to travel southward over the inland ice and so cut off the eastern horn of Greenland, which the expedition had discovered. They succeeded in face of incredible difficulties in marching 160 miles in 20 days, but first Hagen and then Erichsen died, only Bronlund reaching the supplies left on Lambert Island on the northern journey. But Bronlund was worn out, and, after recording the journey in his diary, died alone in the Arctic night. His diary was discovered by Koch in the following year, and that of Mylius-Erichsen by Mikkelsen in 1910.

April 1, 1791 — Vancouver's Surveys

George Vancouver, with two ships, the *Discovery* and the *Chatham*, sailed from Falmouth. Vancouver had sailed as a midshipman under Cook on his last voyage, and he carried out his work of survey with remarkable thoroughness, being much helped by the fine quality of his officers. On Sept 26 the Australian coast was sighted and King George's Sound discovered. The northern coasts of New Zealand were surveyed to supplement the work of Cook, and the *Chatham* group was discovered. Vancouver then proceeded to the Strait of Juan de Fuca, which Meares had considered to be the portal to an inland sea occupying much of the continent of North America and thus making possible easy communication between the Pacific and Hudson Bay. Vancouver meticulously surveyed the labyrinth of channels, determined to leave unexplored no portion of the coast-line which might conceal a possible outlet to the Atlantic. He thus proved that no strait leading across to Hudson Bay could exist in these latitudes. The Columbia River was explored for 84 miles from its mouth. The *Discovery* arrived in the Thames on Oct 20, 1795, after her four and a half years' voyage, during which only one man of the crews of the two vessels died of disease. This arduous, prolonged, and detailed survey of the western coast of America is one of the most remarkable feats of exploration. It attracted little attention at the time, partly because it was scientific rather than spectacular in character, and partly because Vancouver sought no publicity.

April 2, 1906 — Archæology of Central Asia

Sir Aurel Stein started from Srinagar on the second of the three great journeys which have revealed so much of the ancient history of Central Asia. Though the main objects of these expeditions were archæo-

logical, Stein took with him trained surveyors who recorded topographical details with great accuracy. His 1906-8 expedition surveyed the region between Yarkand and the Nan Shan range, and extended his archæological work from Khotan and the Takla Makan (1900-1) to the Lob Nor region and eastwards to China. The third journey covered the whole region between the Tian Shan on the north and the Kuen Lun on the south, extending from the Pamirs to China. Stein has supplemented his classic memoirs on the early history of Chinese Turkestan and Kansu by a series of maps and a geographical memoir.

ERRATUM — Under date "March 14, 1864", for "Sir S. W. Butler" read "Sir Samuel Baker".

## Societies and Academies

LONDON

Geological Society, Jan 27 — G. M. Stockley. The geology of the Ruhuhu coalfields, Tanganyika Territory, with a report on some fossil plants from the Karroo beds in the Ruhuhu River depression, by J. Walton. The area, which is occupied by Karroo rocks, forms a depression between the mountains which lie to the north and south, these are composed of gneisses and other rocks of the primitive system, which are brought into juxtaposition with the Karroo rocks by faults of considerable magnitude. The rocks of the primitive system fall into three groups: (a) highly altered felsitic and acid volcanic rocks, (b) metamorphosed sedimentary rocks, consisting of quartzites, marbles, opicalcites, phyllites, and mica-schists, (c) gneisses and granulites. — L. R. Cox. *Lamellibranchia* from the Karroo Beds of the Ruhuhu coalfields, Tanganyika Territory. Five species, all referable to the genus *Palaeomutela* Amalitsky, are recorded from the lower horizon. Amalitsky's conclusion that the Lower Beaufort mollusca are in most cases identical with species found in the Permian of the Oka-Volga basin and other districts of Russia receives support from the material now studied, although it is considered that the fourteen species recognised by him in his South African material (which has been re-examined) should be reduced to five or six. The upper horizon has yielded numerous shells belonging to a new species of the genus *Unio*, *Unio* has previously been recorded from about the same horizon in North America (several species) and the Dolomites (one species), but not from older rocks. — S. H. Haughton. On a collection of Karroo vertebrates from Tanganyika Territory. The fauna of the Lower Bone Bed, containing Pareiasuria, Dicynodontia, Endiothodontia, and Gorgonopsia, and including new genera and species, is closely allied to that of the Lower Beaufort beds of South Africa, and the horizon is considered homotaxial with the middle part of the Lower Beaufort beds and the equivalent of the upper bone horizon of the Chiweta beds of Nyasaland (Upper Permian). The Upper Bone Bed displays a mingling of Anomodontia with Diapsida (Thecodontia and Theropoda). The Thecodontia are distinct from any known form, but the fauna as a whole shows certain similarities to that of the Rio do Rasto beds of Brazil and the Maleri Stage of India. The conclusion is reached that the beds are probably homotaxial with the non-reptile-bearing Molteno Beds of South Africa (Upper Triassic).

Institute of Metals, March 10 — G. D. Bengough and L. Whitby. Magnesium alloy protection by selenium and other coating processes. These films confer considerable resistance to the corrosive action of sea-

water spray. They are normally produced by immersion for a few minutes in a bath containing selenious acid at laboratory temperature, but may also be produced by rubbing the alloy with porous material dipped in the bath. The film has the property of self-healing to a limited extent, especially when immersed in stagnant sea-water, it is only a few thousandths of a millimetre thick.—Marie L. V. Gayler and G. D. Preston. The age-hardening of some aluminium alloys of high purity. Age-hardening of a duralumin at room temperature and at  $200^{\circ}\text{C}$  is due to some process, as yet undefined, which takes place prior to actual precipitation of  $\text{CuAl}_2$  or  $\text{Mg}_2\text{Si}$  from the aluminium lattice. In conjunction with existing equilibrium data, it is suggested that  $\text{Mg}_2\text{Si}$  as well as  $\text{CuAl}_2$  plays an important part in the process of age-hardening.—C. F. Elam. Some bronze specimens from the royal graves at Ur. Some of the objects found by Mr. C. Leonard Woolley had been cast, others showed signs of subsequent working and annealing.—W. H. J. Vernon. The 'fogging' of nickel. The effect is attributed mainly to the catalytic oxidation of small amounts of atmospheric sulphur dioxide, suspended sulphates play a minor part. There is a critical relative humidity, below which the metal may be exposed, apparently indefinitely, without action taking place, and above which fogging readily occurs. Film formation is approximately halved when light is completely excluded. The formation of the primary film may be largely suppressed by pre-exposure of the metal to an atmosphere containing traces of hydrogen sulphide. Fogging may also be inhibited by alloying the nickel with chromium, or by covering the surface with a film of lanoline.—H. J. Gough and H. L. Cox. The behaviour of single crystals of bismuth subjected to alternating torsional stresses. Throughout the tests no slip bands were observed. In the early stages of the tests numerous bands were produced parallel to the twinning planes, and finally cleavage cracking occurred. The production of twin bands appeared to depend on the sheer stresses on the twinning plane. On the basis of minimum energy, there is no reason to associate any type of movement with stresses tending to cause this movement by the shortest geometrical path, and the process of twinning may be due to stresses which at first sight appear to be incapable of affecting the process.—P. Saldau and M. Zamatorin. The solubility of aluminium in magnesium in the solid state at different temperatures. The solubility of aluminium in magnesium of 99.68 per cent purity has been determined at temperatures up to  $420^{\circ}\text{C}$ . The solubility limit at room temperature is 6.08 per cent aluminium by weight, and this is maintained unchanged until  $300^{\circ}\text{C}$ , after which a rapid increase occurs, the solubility line passing through 10.9 per cent by weight of aluminium at  $400^{\circ}\text{C}$ , and intersecting the eutectic line ( $436^{\circ}\text{C}$ ) at the point corresponding with 12.6 per cent aluminium by weight.—H. O'Neill and H. Greenwood. Observations on the pressure of fluidity of annealed metals. The pressure of fluidity at room temperatures has been designated as the stress at which a loaded rigid punch continuously penetrates a block of ductile metal. Examination of such a partly-punched specimen by hardness tests after sectioning, reveals that the most highly strained regions have a (Meyer) ball index value of  $n=2.0$  and a resistance to indentation equal to the pressure of fluidity. The value of the latter for a given specimen can therefore be determined by a cone or ball test after cold-working the material to the greatest possible extent by rolling. The suggestion is made that the condition of 'critical plasticity' observed by Tresca, Kick, Coe, and others in the course of compression tests, corresponds with the condition

of 'necking' in tensile tests.—W. Rosenhain. The testing of castings. Ideal methods of non-destructive testing being as yet unavailable, the application of the usual mechanical tests to castings is considered. The author favours the adoption of a separately cast test-piece, the use of small samples cut from actual castings being reserved for investigatory purposes. The use of chill-cast and sand-cast test-bars is discussed with special reference to the forthcoming adoption of a standardised sand-cast test-bar for the light alloys of aluminium. Reference is also made to the difficulty of determining small percentage elongations, and the practice followed in cast iron testing of using bending tests, in which deflection is measured as a means of testing ductility, is described.

#### PARIS

Academy of Sciences, Feb. 8.—L. Lecornu and Charles Richet. The rheometric disc, a simple apparatus for measuring the velocity of (ocean) currents.—L. Cayeux. The magnesium deposits of the Paris basin, regarded in their relations with breaks of equilibrium of the sea floor.—William Bowie. A possible cause of earthquakes not evident at the surface of the globe.—Maurice Gignoux was elected *Correspondant* for the Section of Mineralogy.—Paul Delens. The spherical representation of congruences.—Paul Mentre. The projective application of the tetrahedral harmonic complex on the non-special linear complex.—J. Delsarte. A matrix equation.—Jacques Devisme. Some partial differential equations.—Mandelbrojt. The rôle of the Borel monogenic functions in the theory of the Dirichlet's series.—Davin. The elastic and plastic state of an indefinite body in two dimensions perforated by a circular hole and under the action of a uniform force at infinity.—Enrico Volterra. The propagation from ram strokes through a node of a network of mains.—Thadée Banachiewicz. The determination of the vectorial constants of the orbit from two heliocentric points of a star.—Benjamin Jekhowsky. The angle  $S$  which determines the orientation  $j$  of the grand circle of asteroids.—Ch. Volet. The calculation of parabolic double stars.—D. Wolkowitsch. Applications of the ellipsoid of inertia.—E. G. Barrillon. The congruence of straight lines of thrust.—N. Gunther. The problem of cooling.—Pierre Vernotte. The propagation of a velocity of heating in a metallic bar.—M. Pauthener and Mme. M. Moreau-Hanot. The experimental control of the movement of small metallic spheres in an ionised electrical field.—G. Nadjakoff. The formulæ of the three classes of torsion electrometers.—P. Geoffroy and T. Koulomzine. Contribution to the geological study of the massifs known as primary of the Middle Chelif (Algeria).—Paul Fallot. The accidents of the Rif chain along the Xauen transversal.—Henri Erhardt. The nature and the genesis of the palæo-soils of the old loess of Alsace.—Gandillon. Project for utilising the Lake Maracaibo region in Venezuela. It is proposed to divert two small streams now flowing into the lake into the sea, close the neck with a narrow barrage, and after lowering the level of the lake by evaporation, to develop water power by allowing the sea to flow in.—N. Arabu. An attempt at a new classification of the ammonoids of the Trias.—Joseph Lefèvre. A case of unilateral heredity presented by wheat.—P. Vignon. The posterior wing of the Coleoptera.—Mme. L. Randon and Mlle. A. Michaux. The variations, during acute experimental scurvy, of the quantities of sodium and potassium eliminated by the kidneys and present in the blood serum and total blood.—Paul Portier and Frank Emmanuel. The absorption of heat radiations by the wings of Lepidoptera.—Paul Durand. The Weil-Félix reaction in

eruptive fever—D Santenise The hormonal individuality of vagotonin The author compares the properties, chemical and physiological, of vagotonin, a hormone which can be isolated from the pancreas, and insulin, and concludes that insulin and vagotonin are distinct Both hormones are secreted by the liver —M Loeper and A Mougeot The lipo-selection of cations, a new method in experimental hydrology.

## ROME

Royal National Academy of the Lincei Communications received during the vacation, 1931 —S Pincherle A special linear operator (2)—E Pinte Developes of curves in Hilbertian space —L Fantappiè The general expression of linear analytic functionals —M Ghermanesco. The  $n$ -metaharmonic functions of  $p$  variables —B de Finetti The characteristic functions of instantaneous laws endowed with exceptional values —G Lampariello Elastic waves in anisotropic media —G Krall Adiabatic influences of the tides in the Keplerian motion of two gyroscopic celestial bodies —A Weinstein The movement of a fluid through a permeable barrage —A Rosenblatt The stability of the laminar movements of viscous liquids (3) Convergence of the algorithm —G Righini The profile of the line  $\lambda 5183$  of magnesium in the solar spectrum The author's earlier determinations are upheld against the criticisms of Plaskett —V Ricca The Raman spectrum of sulphuric acid and the action on it of an electric field The phenomena arising from the action of an electric field on the Raman spectrum of sulphuric acid are explainable by supposing that the effects on the non-modified lines of the spectrum are due to the motion of the hydrogen ions in the direction of the field, and those on the Raman lines partly to the same cause and partly to the orienting action of the field on the ions —Leo Pincherle: Hull's magnetron A method is given for the theoretical determination of the wave-length of the high-frequency oscillations (electronic oscillations) emitted by Hull's magnetron in the case when the magnetic field is parallel to the axis of the diode —V Polara The Raman spectrum in sugar solutions The Raman spectrum of saccharose exhibits five of the seven lines of the glycerol spectrum and four lines of alcohol spectra It displays, moreover, the various types of linking which, in the molecular structure of compounds of the aliphatic series, are considered to correspond with particular Raman lines —G Scagliarini and P Pratesi Volumetric determination of vanadium and molybdenum Electrochemical considerations on the reducing activity of metallic copper It was shown previously that, in presence of sulphuric acid, copper quantitatively reduces  $\text{Fe}^{\text{III}}$  to  $\text{Fe}^{\text{II}}$  and  $\text{U}^{\text{VI}}$  to  $\text{U}^{\text{IV}}$ , but is without action on  $\text{Ti}^{\text{IV}}$  and  $\text{Cr}^{\text{III}}$  It is now found that, under similar conditions, vanadium and molybdenum undergo quantitative reduction in accordance with the schemes  $\text{V}^{\text{V}} + \text{Cu} = \text{V}^{\text{III}} + \text{Cu}^{\text{II}}$  and  $2\text{Mo}^{\text{VI}} + \text{Cu} = 2\text{Mo}^{\text{V}} + \text{Cu}^{\text{II}}$  —V Caglioti and P Agostini The use of X-rays in quantitative analysis —V Famiani Contribution to the knowledge of the nutritive values of certain cereals Tallarico has shown recently that small-corned grain has a greater nutritional value for turkeys than grain with large corns This result is now confirmed by the data yielded by experiments on growing albino rats fed with wheat, maize, or barley —Giambattista Dal Piaz Course of the lines of dislocation accompanying the intrusive masses of Mounts Croce, Ivigna, and Bressanone in the Upper Adige Tectonic peculiarities of this region indicate that the vast intrusive arch of the Croce-Ivigna-Bressanone-Pusteria mountain range, the tertiary

and non-Palaeozoic age of which has been confirmed by recent investigations, is included in the Dinaric series —G Mezzadrol and E Vareton Comparison between the actions exerted on the development of silkworms by a simple, open oscillating circuit and by one in syntony with a radio-oscillator for ultra-short waves In comparison with the effect of a simple, open metallic circuit, that of an oscillating circuit syntonised with a radio-oscillator results in more rapid development of silkworms, which grow larger and more resistant to disease, form cocoons sooner, and give a greater yield of cocoons

## WASHINGTON, D C

National Academy of Sciences (*Proc*, 17, Nov 15) —George H Parker and Virginia L Paine Progressive degeneration of the lateral-line nerve in the catfish The nerves of several fish were cut behind the gills and the fish killed at regular intervals Secondary degeneration in the myelin sheath moves peripherally and slowly over the nerve The degenerative wave seems to be a progressive metabolic change due possibly to the cessation of supply of a substance from the nucleated region of the neurone —T W Torrey The relation of taste-buds to their nerve-fibres Taste-buds on the barbels of the catfish disappear within eleven days of cutting their nerve supply Degeneration takes only one day Lowering the temperature postpones onset of degeneration but does not affect the time required for degeneration A chemical material is suggested as necessary for the maintenance of taste-buds and for the maintenance of the nerve itself —G H Parker (1) The colour changes in the sea-urchin *Arbacia pustulosa* was reported by Uexkull to be brown in darkness and deep black in the light No colour change has been detected in the allied form *A punctulata* The general conclusion is that chromatophores with their associated colour changes occur in the animal kingdom only when eyes and central nervous organs are sufficiently developed to enable an organism to respond to a luminous environment —(2) Effects of acetyl choline on chromatophores Has slight effect on a common killifish, but none on a spotted frog —Wilder D Bancroft and John E Rutzler, jr Reversible coagulation in living tissue (8) Bulbocapnine is an agglomerating agent for protein sols both *in vitro* and *in vivo* —Karl Sax Crossing-over and mutation Work on *Drosophila* shows a high correlation between crossing-over and mutation, maximum frequency of both occurring at the same region in the chromosome It is suggested that mutations are produced by crossing-over, the most probable agency being unequal crossing-over, natural selection tends to eliminate unequal crossing-over, and this decreases rate of mutation —H. Beckett Lang and John A Paterson A preliminary report on functional psychoses A report of cases of dementia praecox, manic depressive and epileptic psychoses treated on the lines of suggestions made by Prof Bancroft and his collaborators that these conditions are due to over-peptisation or agglomeration of nerve colloids The general conclusions from the effects of treatment with sodium amytal and sodium rhodanate are that these psychoses are accompanied by changes in the nerve colloids, and that these drugs afford a method of observing the effects of known methods of treatment —William T. Richards The heating of liquids by the absorption of sound, and its relation to the energy of intense high-frequency sound waves Dielectric loss in the liquid due to the oscillating electric field producing the sound waves, and contact with the oil transmitting the sound waves and with the containing vessel, are important sources of heat. An apparatus designed to avoid these difficulties gave

for 25 c.c. of water a heating effect of about  $2.5^{\circ}\text{C}$  per minute, corresponding to  $28\text{ cal min}^{-1}\text{ cm}^{-2}$  for an input of 2.5 kw. Bigger effects quoted by other investigators are due mainly to dielectric loss and oil heating—W. H. Zachariassen. The crystal lattice of calcium metaborate,  $\text{CaB}_2\text{O}_4$ . The oscillating crystal method was used. A feature of the structure is the endless strings of  $\text{BO}_3$  groups parallel to the  $c$ -axis—Roy J. Kennedy and Edward M. Thorndike. A search for an electrostatic analogue to the gravitational red shift. An electrodeless discharge in mercury vapour, which could be submitted to an electrostatic field, was examined at zero potential and at potentials of about 50,000 volts above or below zero, by a quartz interferometer maintained at zero potential. No significant change of frequency was observed.

## Forthcoming Events

TUESDAY, MARCH 29

ITALIAN SOCIETY OF EXPERIMENTAL BIOLOGY (Annual Meeting) (at Institute of Physiology, Turin University) —Subjects for discussion—The Carbonic Anhydride Equilibrium in the Blood, introduced by Prof. R. Margaria, and Pharmacological Action and Radioactivity, introduced by A. Benedicenti.

WEDNESDAY, MARCH 30

ITALIAN SOCIETY OF EXPERIMENTAL BIOLOGY (Annual Meeting) (at Institute of Physiology, Turin University) —continued

THURSDAY, MARCH 31

ROYAL AERONAUTICAL SOCIETY (Annual General Meeting), at 6.30

FRIDAY, APRIL 1

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (Annual General Meeting) (at Engineers' Club, Manchester), at 7.—F. J. Slee. Laboratory Tests of Lubricants and their Relation to Engine Tests.

## Official Publications Received

### BRITISH

Transactions of the Institute of Marine Engineers, Incorporated Session 1932, Vol. 44, No. 1, February. Pp. 56+xxxiv (London).  
Liverpool Observatory and Tidal Institute. Annual Report, 1931. Pp. 15 (Liverpool).  
Reports of the Imperial Economic Conference. Twentieth Report. The Wheat Situation, 1931. Pp. 121 (London: H.M. Stationery Office). 6d net.  
Air Ministry. Aeronautical Research Committee. Reports and Memoranda. No. 1300. Collected Reports on British High Speed Aircraft for the 1927 Schneider Trophy Contest. With an Introduction by W. L. Cowley. Pp. iv+372+232 plates (London: H.M. Stationery Office). 20s net.  
Journal of the Chemical Society. February. Pp. vi+387 725+vi (London: Chemical Society).  
Proceedings of the Royal Irish Academy. Vol. 40, Section B, No. 13. The Nature of the Metabolic Regulation of the Body Temperature and its Relation to Temperature Sensations. By J. M. O'Connor. Pp. 175 193 (Dublin: Hodges, Figgis and Co., London: Williams and Norgate, Ltd.). 6d.  
The Economic Proceedings of the Royal Dublin Society. Vol. 2, Nos. 27 28. Influences of Heating and Agitating Milk before Separation on the Fat Loss in the Skim Milk, by J. Lyons and W. Finlay, The Accuracy of Fat Determinations in Buttermilk, and the Effect thereon of the Presence of Lecithin, by J. Lyons and W. Finlay. Pp. 423 459 (Dublin: Hodges, Figgis and Co., London: Williams and Norgate, Ltd.). 2s.  
Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1930-1931. (Cmd. 4008). Pp. 153 (London: H.M. Stationery Office). 2s. 6d net.  
Journal of the Royal Statistical Society. New Series, Vol. 95, Part 1. Pp. vi+1+186 (London: Royal Statistical Society). 7s. 6d.  
The Proceedings of the Physical Society. Vol. 44, Part 2, No. 242, March 1. Pp. viii+115 229 (London: Physical Society). 7s net.  
Transactions of the Hull Geological Society. Edited by T. Sheppard. Vol. 7, Part 3, 1930-1931. Pp. 77-103 (Hull: A. Brown and Sons, Ltd.). 5s.  
The Quarterly Journal of the Geological Society of London. Vol. 88, Part 1, No. 349, February 25th. Pp. 111 (London: Longmans, Green and Co., Ltd.). 7s. 6d.  
Researches published from the Wards and Laboratories of the London Hospital during 1931. 32 papers (London: H. K. Lewis and Co., Ltd.). 7s. 6d net.

No 3256, VOL 129]

The Journal of the Royal Technical College being a Record of some of the Research Work carried out in the College by the Staff and Senior Students. Vol. 2, Part 4, January. Pp. iv+571 710 (Glasgow: Robert Anderson and Sons, Ltd.). 10s. 6d.

Navy (Health). Statistical Report of the Health of the Navy for the Year 1930. Pp. 148 (London: H.M. Stationery Office). 2s. 6d net.  
Commonwealth of Australia. Council for Scientific and Industrial Research. Pamphlet No. 24. The Preservative Treatment of Fence Posts (with Particular Reference to Western Australia). By J. E. Cummins. Pp. 34 (Melbourne: H. J. Green).

The Pasteur Institute of Southern India, Coonoor. The Annual Report of the Director for the Year ending 31st December 1930, together with the Twenty-fourth Annual Report of the Central Committee of the Association for the Year ending 31st March 1931. Pp. 76 (Madras: Methodist Publishing House).

Air Ministry. Aeronautical Research Committee. Reports and Memoranda. No. 1414 (Ae. 535—T. 3085). Drag and Interference of a Nacelle when Installed on the Upper Surface of a Wing. By W. G. A. Perring and C. Callen. Pp. 24+13 plates. 1s. 3d net. No. 1430 (T. 3169). Simple Tilting Manometer for Rapid Reading. By Dr. James Small. Pp. 4+3 plates. 6d net. No. 1427 (T. 3047, a and b). Primary Stresses in the Hull of a Rigid Airship. By L. Chitty and R. V. Southwell. Pp. 41+5 plates. 2s net (London: H.M. Stationery Office).

Proceedings of the Royal Society. Series A, Vol. 135, No. A827, March 1. Pp. 282 511 (London: Harrison and Sons, Ltd.). 12s.

South Australia. Department of Mines. Mining Review for the Half-Year ended June 30th, 1931. (No. 54). Pp. 134. Annual Report of the Director of Mines and Government Geologist for 1930. Pp. 8 (Adelaide: Harrison Weir).

Proceedings of the Prehistoric Society of East Anglia for 1931. Vol. 6. Part 4. Edited by G. Maynard. Pp. xvi+253 385+plates. 20-37, (Ipswich: East Anglian Daily Times Co., Ltd.). 15s net.

Transactions of the Optical Society. Vol. 32, 1930-31, No. 4. Pp. iv+129 164 (London: Optical Society). 10s.

### FOREIGN

U.S. Department of Commerce. Bureau of Standards. Bureau of Standards Journal of Research. Vol. 8, No. 1, January, Research Papers Nos. 396-406. Pp. 167 (Washington, D.C.: Government Printing Office). 40 cents.

U.S. Department of the Interior. Office of Education. Bulletin, 1931, No. 20. Biennial Survey of Education in the United States, 1928-1930. Chapter 4. Industrial Education. By Maris M. Proffitt. Pp. 44. 10 cents. Bulletin, 1931, No. 20. Biennial Survey of Education in the United States, 1928-1930. Chapter 20. National Surveys of the Office of Education. By Walton C. John. Pp. 32. 10 cents. Bulletin, 1931, No. 22. Record of Current Educational Publications, July 1—September 30, 1931. Edited by Martha R. McCabe. Pp. i+86. 15 cents (Washington, D.C.: Government Printing Office).

Institutul Meteorologic Central al României. Memoriu și Studii, Vol. 1, No. 3. Climat de la Dobroudja și din litoral de la Mer Noire. Par. Enrie Obetelișanu et Const. A. Dissescu. Pp. 71+15 planches. 200 lei. Date Climatologice, Vol. 1, No. 1. i. Moyennes déduites de la période 1890-1915 de 32 stations de l'île, ii. Moyennes annuelles et mensuelles de pression, température et précipitations atmosphériques, de 14 stations, iii. Moyennes horaires des éléments météorologiques de Bucarest. Recueillies par Const. A. Dissescu. Pp. 128+1 planche (București).

Union Internationale de Chimie. Table Internationale des poids atomiques. Deuxième rapport de la Commission des poids atomiques, 1932. Pp. 32 (Paris).

Ministry of Agriculture, Egypt. Technical and Scientific Service. Bulletin No. 112. Watering and Spacing Experiments with Egyptian Cotton. By Dr. J. Templeton. Pp. 7+6 plates (Cairo: Government Press). 2 P.T.

R. Osservatorio Astrofisico di Catania. Annuario 1932. Pp. iv+84 (Catania).

Abhandlungen der Bayerischen Akademie der Wissenschaften, Mathematisch naturwissenschaftliche Abteilung, Neue Folge, 8. Theoretische und praktische Untersuchungen über die Bestimmung der Randverdunkelung der Sonne aus aktinischen Energiemessung, während einer Sonnenfinsternis. Von Paul Harzer. (Publication der Sternwarte in Kiel, Nr. 18). Pp. 60 (München: R. Oldenbourg).

Beiträge zum Modus der Ossifikationsvorgänge in der Anlage des Extremitätenskelettes bei den Equiden der Verknocherungsprozess in der Pferde- und Eselghedmasse auf Grund röntgenologischer Untersuchungen. Von Max Kupfer. (Denkschriften der Schweizerischen Naturforschenden Gesellschaft, Band 67). Pp. viii+352+31 Tafeln. (Zürich: Gebroder Fretz & G.).

U.S. Department of Agriculture. Technical Bulletin No. 274. Hot Water as an Insecticide for the Japanese Beetle in Soil and its Effect on the Roots of Nursery Plants. By Walter E. Fleming and Francis E. Baker. Pp. 42 (Washington, D.C.: Government Printing Office). 15 cents.

Proceedings of the American Academy of Arts and Sciences. Vol. 66, No. 11. Bermuda during the Ice Age. By Robert W. Sayles. Pp. 331-468+13 plates. (Boston, Mass.) 2 dollars.

Publications of the Observatory of the University of Michigan. Vol. 4, No. 5. A Study of S Sagittae. By John A. Aldrich. Pp. 75 92. Vol. 4, No. 6. A Device for the Differential Correction of Conditioned Orbits by Leuschner's Method. By Allan D. Maxwell. Pp. 93-99. (Ann Arbor, Mich.).

Publikationer fra det Danske Meteorologiske Institut. Aarbøger forholdene i de Arktiske Have (The State of the Ice in the Arctic Seas), 1931. Pp. 16+5 maps. (København: G. E. Gad).

Government of el 'Iraq. An Inquiry into Land Tenure and related Questions. Proposals for the Initiation of Reform. By Sir Ernest Dowson. Pp. 78+5 plates. (Baghdad, The Ministry of Finance, London: The 'Iraqi Legation). 3 rupees, 4s. 6d.

U.S. Department of the Interior. Office of Education. Bulletin, 1931, No. 19. Circular Letters as a Supervisory Agency. By Jessie M. Parker. Pp. v+80 (Washington, D.C.: Government Printing Office). 15 cents.

Smithsonian Institution. United States National Museum. Bulletin 159. The Birds of the Natuna Islands. By Harry C. Oberholser. Pp. vi+137 (Washington, D.C.: Government Printing Office). 25 cents.



SATURDAY, APRIL 2, 1932

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## Problems of Science Teaching

TWO striking addresses dealing, *inter alia*, with the teaching of science in secondary schools have recently appeared—the Pedler lecture of the British Science Guild, by Prof Irvine Masson,<sup>1</sup> and the presidential address to the Science Masters' Association, by the headmaster of Harrow.<sup>2</sup> They go back once more to the views of Huxley, to those of the representative committees of the British Association of 1917 and 1928, under the chairmanship of Sir Richard Gregory,<sup>3</sup> and to those of the Prime Minister's Committee of 1916–18 presided over by Sir J J Thomson,<sup>4</sup> when they suggest that for the vast majority of boys (and girls) what is needed is an all-round training in science, broad and simple, and including not only physics and chemistry, but also biology, geology, and astronomy.

The change would involve sacrifices both on the literary side and, for pupils who already take science, on the scientific side. On the scientific side, Prof Masson suggests that the prematurely intensive study of a particular science at school is directly harmful to the later study of the science itself. This proposal, however, raises other problems, and some of fundamental importance not obvious at once, both in education, in its narrower sense, and also in citizenship. Like Dr Norwood, we hear the contemptuous 'Smattering!' of some of our readers, nor are we unmindful of 'H E A.'s' courageous and reiterated demand that what should be taught in secondary schools is 'scientific method',<sup>5</sup> and his plea that in the right kind of scientific teaching the principle must be insisted on that 'nothing may be taken for granted'.

The doctrine is a simple one—unfortunately, too simple for truth. Even the author of the epoch-making "Discours de la méthode", Descartes, did not suspect all the things he took for granted, and the 'deductions' cheerfully made by a schoolboy from the simplest scientific experiment may be matters still under discussion by the keenest scientific intellects of our time. Imagine a teacher working through the more important books on method published since Mach's "Science of Mechanics"—we have in mind authors like Karl Pearson, Poincaré, James Ward, Russell, White-

<sup>1</sup> Published by the British Science Guild, 6 John Street, Adelphi, W C 2 1s.

<sup>2</sup> *School Science Review* for March 1932.

<sup>3</sup> Report on Science in School Certificate Examinations, with syllabuses by various teachers. London: British Association for the Advancement of Science. 1s.

<sup>4</sup> Natural Science in Education (§§ 41, 49, and *passim*). London: H M Stationery Office. 1s 6d net.

<sup>5</sup> See "The Teaching of Scientific Method, and Other Papers on Education", by H E Armstrong (2nd edition, 1925, pp 1-10, and 256-7), and the two articles on "National Needs" by 'H E A.' in NATURE for Nov 14 and Dec 26, 1931.

head, T P Nunn, N R Campbell, Meyerson, H Levy, and the quite recent books by Dr Herbert Dingle on "Science and Human Experience" and by Dr Harold Jeffreys on "Scientific Induction"—and then trying to tell a class of schoolboys what is meant by such phrases as 'cause and effect', 'scientific explanation', or 'error of experiment' (purposely omitting the old terms we used to think so simple, such as 'mass', 'energy', 'atom') Could he possibly assure them that in his teaching 'nothing was taken for granted'?

In every example of scientific experiment which a teacher will give to his pupils, not few but many assumptions will be made, if he is not utterly to bewilder them at this stage. Newton's famous "hypotheses non fingo" is probably largely responsible for the notion that 'nothing is taken for granted' in teaching physical science. The phrase occurs in the penultimate paragraph of the "Principia", it was intended by Newton only to apply to part of his work, and it is in striking contrast with the final paragraph of the "Principia" itself, and with what Priestley calls the "bold", "eccentric" notions of the "Opticks", with its "Queries". The fundamental distinction between verifiable and unverifiable hypotheses drawn by writers like Nunn<sup>6</sup> and Dingle,<sup>7</sup> and the fruitfulness of the great 'unverifiable' hypotheses, such as those of the atom and electron, elevated by some of our most distinguished men of science to the rank of 'ultimate realities'—all these are things which the school-teacher of science ought to have at the back of his mind. To explain them in detail to his pupils would, however, be an impossible task. The 'common-sense' of science is the most elusive of concepts.<sup>8</sup>

While differing from 'H E A' in his views of scientific method, we are in warm agreement with his recent utterances on the artistic aspects of science, aspects of the utmost value to the teacher trying to secure the interest of his pupils. If we agree with Dingle that the material of science consists of the elements of our experience actually or potentially common to all normal people (whereas art and religion are concerned with experiences which may or may not be shared by others), we nevertheless see the *advances* of science have in them something individual, giving to many pupils, if adequately presented, an artistic emotion. In the Report of the British Association Committee of 1917 on Science Teaching in Secondary Schools,

<sup>6</sup> "The Aims of Scientific Method" (1907), pp 129, 130

<sup>7</sup> "Science and Human Experience" (1931), pp 46-50

<sup>8</sup> In his interesting B B C pamphlet on "Science in Perspective" (1931), Prof H Levy gives what he himself terms "the dim outline of a method"

of which Prof Armstrong himself was a member, it is suggested that teachers should not fail to give scope in their teaching to the 'wonder-motive', the 'utility-motive', and the 'systematising motive'. By 'wonder-motive' is not meant the desire to wonder at astronomical immensities or the infinitely small, but at the achievements of individual men in overcoming difficulties, a wonder to be excited as much by the binomial theorem as by the cure for hydrophobia or by wireless telephony. "Execution", says Blake somewhere, "is the chariot of genius". The achievements of genius may be inspiring to many a boy or girl who would be unable to follow a logical analysis of method, of which the author himself may have been unconscious in making his discovery. Prof S Alexander has recently put forward views of which Blake's may be an anticipation.

From these general considerations we turn to another aspect of the matter, not less important. Dr Norwood demands that "windows should be opened in the pupils' minds in all directions". The blindness of the average man to the problems of biology apparent in our educational and administrative systems may, to quote a recent utterance of Dr H H Dale, "become a real danger to our civilisation". "An intelligent appreciation of the fundamental facts of biology is not yet regarded as a necessary part of the equipment of an educated man".<sup>9</sup> About the fact there can be no doubt. The statistics of the School Certificate Examination published by the second British Association Committee under the chairmanship of Sir Richard Gregory, and by Dr Masson, show that only about one per cent of the candidates present themselves in biology or zoology (though a much larger proportion, mostly girls, take botany), and under present conditions the examination-room may be regarded as an approximate reflex of the class-room. There are some schools in which this is not the case, but they are few. We have quoted several authorities in favour of the policy advocated by Dr Masson and Dr Norwood: one other may be cited—the recent Report of the Prime Minister's Committee on the Education and Supply of Biologists, presided over by Lord Chelmsford.<sup>10</sup> "We hold strongly", the Report says, "that no boy should be allowed to leave school without having been introduced to biology" (loc cit, p 23).

Are there in English education at this moment

<sup>9</sup> "Biology and Civilisation", the Norman Lockyer Lecture for 1931 (p 17). British Science Guild, John Street, Adelphi, W C 2. 1s

<sup>10</sup> Published by H M Stationery Office, 1932, for the Economic Advisory Council. 1s net



any powers capable of securing this result? The Chelmsford Committee is conscious of the impotent, not to say ridiculous, delay that has followed the recommendations of its predecessors. The Committee wants steps to be taken by the Board of Education, in concert with the other Government departments. It wants the universities and great public schools to be consulted, but it strangely omits to mention by name the bodies which of all are the most important, if any large number of pupils are to be affected, the local education authorities. Is anything being done? P J H

### Seismology

*Handbuch der Geophysik* Herausgegeben von Prof Dr B Gutenberg Band 4 (Lieferung 1) *Theorie der Erdbebenwellen, Beobachtungen, Bodennunruhe* Von Prof Dr B Gutenberg Pp 298 30 gold marks Lieferung 2 *Seismometer, Auswertung der Diagramme*, von Dr H P Berlage, Jr, *Geologie der Erdbeben*, von Prof Dr A Sieberg Pp 299-686 45 gold marks (Berlin Gebruder Borntraeger, 1929-1930)

PROF B GUTENBERG, a very distinguished seismologist, is general editor and chief author of what our German colleagues call a handbook of geophysics, in ten mighty volumes. There are more than forty other contributors. The two parts under review form the first instalment. The whole, when complete, should be a very comprehensive account of the whole of geophysics, particularly welcome on account of the scattered nature of the literature of the subject.

The first part is entirely by Prof Gutenberg, and half the second by Dr H P Berlage. These cover the whole of instrumental seismology, beginning with the theory of elastic waves, and proceeding to an account of the use of the instrumental records to infer the structure of the earth. The types of seismograph used are described in detail. The accounts given are very full. In places the reviewer might wish them fuller, and a few items are included, with little or no comment, which scarcely seem worth preserving in a work of permanent value. But on the whole we must welcome the most complete account of modern seismology yet published. Very little of any importance has escaped mention and discussion, and the references to original papers in all languages are abundant. This will be the standard work of reference for many years.

The remaining half of the second part, by Prof

A Sieberg, is entitled "Geology of Earthquakes", and deals with macroseismology, or, as the author says, the study of earthquakes in the popular sense—their destructive effects on buildings, the visible effects on the earth's surface features, the movements felt by man, the sea waves produced, and so on. If I devote most attention to this part it is because I have learnt most from it.

The connexion between the local effects in the 'shaken region', that is, the region where motion can be felt, and the movements produced in instruments at a safe distance, has received very little discussion hitherto, and it seems to me that most important advances in both sides of the subject must develop from the study of their interrelations. As a specimen of the degree of separation that exists, it may be mentioned that Dr C. Davison's excellent book, "The Founders of Seismology", contains no reference to Poisson or Rayleigh, who predicted theoretically the three principal types of elastic waves, and Davison might justly reply that none of my own works mentions Mallet or Mercalli. Yet the movement that is felt and in many cases shakes down houses is merely an elastic wave of great intensity, and on the other hand, the waves observed at a great distance have been produced in the shaken region, and must show traces of its properties.

The relation is already becoming an acute problem in instrumental seismology, hitherto we have concentrated attention on the various plutonic layers, but it is becoming clear that the sedimentary layer produces a controlling influence on some phenomena. I hinted very tentatively that some pulses observed in the Jersey earthquake of 1926 might be compressional waves in the sedimentary layer. Tillotson and Maurant have obtained confirmatory evidence, while Stoneley detects signs of an influence of the sedimentary layer on the shorter distortional waves. Now if there are bodily waves transmitted horizontally in the sedimentary layer, the focus must be in that layer. But most continental seismologists (including Gutenberg), in the cases they have investigated, claim to have found foci in the granitic layer at depths of the order of 30 km. I consider these estimates excessive, even on the actual data used, but clearly they are out of the question if the foci are not in the granitic layer at all.

It is here that macroseismology may provide a criterion, and abundant data are given by Prof Sieberg. If the crust were uniform, the intensity would be greatest at the epicentre, and would fall off steadily with distance. This is not confirmed

by observation. There is, of course, a general decrease with distance, but the exceptions are numerous. Usually there are isolated patches of high intensity, in one case (p. 620) the region of greatest intensity actually encloses three separate regions of lower intensity. Sieberg with good reason attributes these variations to differences in the nature and structure of the local sediments. But could they exist if the focus was below the sedimentary layer? The waves at distances comparable with the depth of focus would be incident at high angles on the interface between the sedimentary and granitic layers, and at still higher angles on the outer surface. Great variations in these circumstances seem unlikely. Certainly they are less likely than if the waves felt are transmitted nearly horizontally in the sedimentary layer and subject to its irregularities through the whole of their path. Sieberg does not discuss this point directly, but he contributes much evidence that most earthquakes are due to motion on visible faults, or to infalls of rock in caves, when the focus is certainly in the sedimentary layer, and it does not appear that the seismograms of earthquakes known to be of these types differ from those of the near earthquakes studied in most discussions.

The earthquakes believed by Prof. Turner to have had foci at depths of the order of 300 km. are, of course, in another class, and it cannot be said yet that we have any clear idea as to their cause, but the recent work of Stoneley and Scrase has, at any rate, put their existence on a secure footing.

The book is well and abundantly illustrated, both by diagrams and maps and by actual photographs of the effects of earthquakes. The value of the maps would have been greater if all of them, instead of only a few, had been accompanied by scales of distance.

It is assumed, a little too naively, I think, that the felt intensity and the destructive effect depend only on the acceleration of the ground. In many cases this is probably true, as, for example, in the house shown on p. 572, where the inertia of a too heavy upper story has made it slide horizontally over the lower through about a yard. But there may be cases where the determining factor is the range of variation of velocity, and there must be some where it is the final displacement. C. Haussmann is quoted on p. 612 as finding a displacement of 20 metres in  $2\frac{1}{2}$  years on a known fault, without any earthquake in the usual sense, and therefore negligible acceleration, yet if a building had been over this fault it would have been destroyed as effectively as any in the San Francisco

earthquake. R. D. Oldham's work on this question (*Q. J. Geol. Soc.*, 82, 67-92, 1926) has apparently not come to the author's notice. Again, while too great an acceleration of the ground may break a building fastened to it, it may not throw a man off his feet if it is reversed before he has had time to fall, then the range of velocity will give a better criterion than the acceleration. So far as the criteria agree, they indicate a rough constancy in the period of the motion.

Many and varied are the geographical effects described. On p. 581 is a map of a recent earthquake in Bulgaria, showing the actual development of a miniature rift valley. There are fault scarps, landslips, waterfalls, sand and mud cones, and sea waves. One occasion is mentioned when an earthquake caused a landslip, which blocked a stream and formed a lake, in which mosquitoes bred and led to an epidemic of malaria.

The author is everywhere critical, and his work can be recommended as a stimulating contribution to a complicated subject.

HAROLD JEFFREYS

### The Wild Roses of Central Europe

*Synopsis Rosarum Spontaneorum Europæ Mediæ. Übersicht über die mitteleuropäischen Wildrosen mit besonderer Berücksichtigung ihrer schweizerischen Fundorte.* Von Dr. Robert Keller. (Denkschriften der Schweizerischen Naturforschenden Gesellschaft, Band 65.) Pp. xii + 796 + 40 Tafeln. (Zürich: Gebrüder Fretz & A.-G., 1931.)

THE publication of this monograph marks a definite stage in the history of the taxonomy of *Rosa* and also raises important questions of more general interest. It represents the consistent labours of half a century of the eminent rhodologist, Dr. Robert Keller, of Winterthur, who is to be congratulated on the crowning achievement of his life's work. It is probably the last word on the problem of species in *Rosa* of the purely morphological school of taxonomy before the new genetical taxonomy takes up its inevitable position as an exact science on an experimental basis. In his foreword, Dr. Keller remarks that the parents of the 428 natural hybrids described have been determined morphologically and not experimentally. That expresses in a sentence the fundamental difference between the old and the new taxonomy.

The main object of this Synopsis is, no doubt, to enable collectors to identify and name their specimens. Dr. Keller has achieved this end with distinction, and any wild rose from Central Europe

that cannot be traced in his synopsis of 2407 forms may with high probability be regarded as new to science. There is, however, another important aspect of this monograph which is of interest to biologists as a whole, and that is Keller's concept of a species. Dr Keller, unlike some of his contemporaries—for example, Gandoger, who made 5549 'species' of the genus—has no illusions about the status of the European species, notwithstanding the prolixity of forms that he has distinguished by name. He prefers to take a broader view even than Crépin did in his later years, by reducing the number of Central European species to 26, although, unlike Crépin, he admits 15 subspecies and about 100 varieties and forms of each species.

Except for the subspecies, this is a wise and satisfactory classification. Keller divides the Central European roses into two main groups, *Sociales* and *Arcuatae*, while *Sociales* is further divided into *Erectae* and *Erecto-arcuatae*. In many respects this grouping is natural, although at least 6 of the 22 species in *Arcuatae* are social in root-habit, with erect stems, as in the *Erectae* of the *Sociales*. The 7 sections of the genus with their 6 subsections are natural groups, except that the pentaploid *Stylosae* and the hexaploid *Jundzilliae* might well have been placed as subsections of *Caninae*, and *Eucaninae* divided into two or more subsections.

With a few exceptions, Dr Keller's species appear to be good genetical species, but 7 of his subspecies prove to be equally good species. With regard to nomenclature, Dr Keller in substituting *R. pendulina* L. for *R. alpina* L., *R. glauca* Pourr. for *R. rubrifolia* Vill., *R. eglanteria* L. for *R. rubiginosa* L., and *R. obtusifolia* Desv. for *R. tomentella* Lem., observes the strict rules of priority. He does not, however, substitute *R. Sherardii* Dav. 1813 for *R. omissa* Desegl. 1864 (misprinted "1894" on p. 245) although it is admitted as a synonym, nor does he substitute *R. caesia* Sm. 1811 for *R. Afzeliana* Fries 1816, nor *glaucophylla* Winch 1816 for *vosagrica* Desp. 1828. Dr Keller still maintains the old specific name *R. villosa* L. which was specifically abandoned in the International Rules, and he makes his subspecies facultatively autonomous by repeating the generic initial before the subspecific name.

In citing *R. gallica* L. 1753, instead of *R. gallica* L. 1759, Dr Keller overlooks Crépin's discovery that the original *gallica* of Linnæus of 1753 was a species of *Caninae* and not the familiar plant that Keller describes. Moreover, *R. gallica* L. 1759 is not the earliest name for the plant, since *R. rubra*

Blackw. 1757 precedes it, but the oldest legitimate name for the genetical species is *R. centrifolia* L. 1753, which happens to be the original name given by Theophrastus.

For several reasons it is desirable that the pentaploid species *R. tomentosa* Sm. should be removed from the tetraploid species of *Vestitae*. The hexaploid species *R. Pouzianii* Tratt. should also be separated from the pentaploid *R. canina* L. and the hexaploid species *R. inodora* Fries (*sensu stricto*) from the pentaploid *R. agrestis* Sav.

Dr Keller's 15 subspecies are not so satisfactory as his species. All are in the section *Caninae*, and 7 are regional groups which work out as genetical species, while 2 are common to the whole area, and prove to be genetical varieties. It is now generally recognised that the multitudinous minor variants in *Rosa*, of which Dr Keller describes no less than 2366, each with a set of key characters and a Latin diagnosis, consist almost exclusively of Mendelian segregations following generations of natural crossings of the results of gene mutations and chromosome transmutations within and without the species, leading to almost endless combinations of characters, some dominant and others recessive, some homozygous and others heterozygous. The classification of these minor variants is consequently a matter of extreme difficulty. Dr Keller, in accordance with the Rules of Nomenclature, has made a classification of them into varieties and forms, and recently Christ, Wolley-Dod, and Heslop-Harrison have adopted a similar system. The chief difficulty is that each author has his own opinion whether the same segregate should stand as a variety or a form, and they do not always agree.

It is evident that a standard of classification on genetical lines is necessary for these minor variants of *Rosa*. Engler's idea that the term 'form' should be restricted to a fluctuating somatic modification and Du Rietz's suggestion that the term 'variety' should be confined to local homozygous biotypes (races) seem to be quite impracticable in *Rosa*, and it is hoped that the publication of this monograph will arouse interest among systematists generally so that a satisfactory classification of these minor variants in plants and animals may emerge.

In addition to copious references to authors, synonyms, and geographical distribution, the "Synopsis" contains an ingenious and extensive key to the species, which is made rather unwieldy by the inclusion of parallel varietal characters which are out of place in specific diagnoses. A full analysis of the local distribution of forms in Switzerland is

given, and statistical tables of leaflet numbers are shown under each species. A chapter on the relative fertility and sterility of species and natural hybrids shows the necessity for caution in estimating the percentage of functional pollen grains, and that the complications due to facultative apomixis should also be taken into account. Abstracts of 24 systems of classification of the European roses from 1813 until 1925 emphasise the taxonomic difficulties of the genus. In a chapter on the evolution of species, Dr Keller accepts Tackholm's theory of the origin of the *Caninae* by hybridisation in the Pleistocene period.

Forty excellent coloured plates are issued in a separate binding, which well and truly represent the species and hybrids illustrated. There is a useful and indispensable index, but the synonyms are apparently too numerous to be included. The publication of this important work enhances the reputation of all concerned in its production, and it will no doubt long remain the standard work on the roses of Central Europe. C. C. HURST

### Morphology and Evolution

*Morphologische Gesetzmässigkeiten der Evolution*

Von Prof. Dr. A. N. Sewertzoff. Pp. xiv + 371.

(Jena: Gustav Fischer, 1931.) 22 gold marks.

FOR a quarter of a century, Prof. Sewertzoff and his pupils have been working with the aim of obtaining general principles with the help of which to correlate the present state of knowledge concerning evolution. He came early to the conclusion that this object was most likely to be achieved by a study as detailed as possible of a particular group of animals, for which purpose he selected the vertebrates, paying particular attention to the hard parts so as to be able to make use of palæontology. His book, now under notice, is divided into two parts, of which the first deals with the evolution of the lower vertebrates, the second with the general principles derived from a consideration of such evolution.

In his survey of the history of the vertebrates, Sewertzoff adheres mainly to the generally accepted view. It must be noted, however, that he imagines the early craniates to have had three visceral clefts in front of the hyoid arch. This is one less than he formerly claimed, but it is still one too many, for the evidence from the somites, nerves, visceral arches and clefts, and hypophysis, all points to the premandibular somite (and, therefore, arch) as the original foremost of the whole series.

Sewertzoff departs from custom in contending

that the sturgeons are derived more or less directly from selachian-like ancestors. Space is lacking for a detailed consideration of this point, and it must suffice to say that the evidence which Sewertzoff brings forward does not seem to be adequate to refute the view generally held by the palæontologists of Great Britain, to the effect that the sturgeons are degenerate descendants of the palæoniscoids.

There are a few errors in this part of the book. *Lepidosteus* does not have cosmoid scales, the kidney tubules opening into the pronephric ducts in the early Protocranata were certainly not nephridia, and the nephridia equally certainly did not open into the coelom in the primitive Acrania, seeing that they are closed in *Amphioxus*. But these errors do not invalidate the general lines of Sewertzoff's scheme of vertebrate evolution, which is stimulating if not wholly acceptable. It may be mentioned in passing that while textbooks of morphology are not wanting, there is a need for works on the phylogeny of animals, on the lines of Sewertzoff's sketch.

Coming now to the second part of the book, Sewertzoff makes it clear that he is concerned not with the causes of evolution, but with the manner in which it has occurred, and with the morphological principles involved. He reveals himself as a staunch Darwinian and the whole stage of his thought is set in terms of adaptiveness of organs and of success or failure of organisms in the struggle for existence. He begins by distinguishing two main directions in evolution: the biologically progressive, leading to the production of large groups, rich in sub-groups and individuals, and expansion of range; and the biologically regressive, leading to extinction.

In the biologically progressive direction, Sewertzoff recognises four types or modes: (1) Large changes of general adaptive significance, which raise the degree of organisation of the body and the intensity or energy of the life-processes. Examples of such 'aromorphoses' are the evolution of the brain, sense organs, and heart in the Protocranata, and of the jaws, tail, and paired fins in the Gnathostomes, the lungs, the neck, and feathers of higher forms. It may be noted that aromorphoses do not tie the organism down to any restricted mode of life. (2) Changes which definitely tie the organism to a definite more or less restricted mode of life, without increasing the degree of organisation or of energy output. These changes he calls 'idioadaptations', and holds them responsible for the divergence between rays and sharks, flat-fish and carps, snakes and lizards. Superficial changes of

form and colour also belong here, and a particular aspect of idioadaptation is specialisation. It is to be noted that periods of aromorphosis and idioadaptation may alternate in the history of a group, but the author knows of no case of a group which has undergone specialisation reverting to aromorphosis.

The third and fourth of Sewertzoff's modes are cænogenesis, or adaptive changes confined to early stages of development, and degradation or the acquisition of structures or their loss associated with sessile and parasitic modes of life. It would seem, however, that these categories could conveniently be included in the first two—degradation under idioadaptation, and cænogenesis under idioadaptation or aromorphosis according to the nature of each case.

After an inquiry into the principles which govern the alterations which organs undergo in evolution, Sewertzoff considers the relation between ontogeny and phylogeny. He rejects the Haeckelian view of the pressing back of adult ancestral stages into the young stages of the descendants, and agrees with the view which is constantly gaining favour, to the effect that "evolution is not the alteration of the characters of the ancestral adults, but a modification of the ontogenies of the descendants." As to the time in ontogeny when the evolutionary novelty may arise, Sewertzoff shows that it may be early on, or in the middle, or at the end of the period of morphogenesis, leading to what he calls 'archallaxis', 'deviation', and 'anaboly', respectively. In the latter case, evolution may proceed by the addition of new terminal stages of morphogenesis to the last stage of morphogenesis (not the adult stage) of the ancestor. In this case, the terminal stages of morphogenesis of the ancestors may be repeated, or 'recapitulated'.

The value of this part of Sewertzoff's book is all the greater from the fact that he has purposely made a number of new observations with which to illustrate his points. Such are, in brief, the views which Sewertzoff puts forward as his theory of phylembryogenesis. An interesting question now arises: Is evolution by aromorphosis more likely to occur as a result of the introduction of novelties at the early, middle, or late stages of ontogeny? Sewertzoff does not commit himself on this point.

As a result of a consideration of cases in which the time of appearance in ontogeny of certain evolutionary novelties may reasonably be surmised, it has recently been suggested that the chief characters of the large groups are more likely to have originated as novelties in early stages of development than the reverse. Large groups may also

have characters which arose as late ontogenetic variations, but it is suggested that these are more likely to lead to the production of groups of small classificatory value. In this way it can be understood how the evolutionary capacity of large groups is greater than that of small ones, for, as a rule, the smaller the classificatory value of the group, the more specialised to a particular mode of life are its characters. Sewertzoff himself gives several examples which bear out these views, concluding that major novelties arise by archallaxis, while anaboly leads to the modification of something already present.

Prof Sewertzoff's book is to be warmly recommended as a thought-provoking piece of work, and is all the more valuable because many of the original publications on the subject by himself and his pupils are somewhat inaccessible.

G. R. DE BEER

### Progress of Chemistry

*Chemistry at the Centenary (1931) Meeting of the British Association for the Advancement of Science.*  
Pp xi + 272 (Cambridge W. Heffer and Sons, Ltd., 1932) 7s 6d net

THE centenary meeting of the British Association, following on the celebrations of the centenary of Faraday's discovery of electromagnetic induction and preceding the Clerk Maxwell centenary at Cambridge, brought to London a number of eminent foreign visitors which was quite unique in the history of the Association, and is likely to remain unrivalled for many years to come. Although the visitors who came to England to pay honour to the work of Faraday and of Maxwell were primarily physicists, the boundaries between physics and chemistry have been so far obliterated that the officers of Section B (Chemistry) of the British Association were able to make full use of the opportunity which the occasion presented of providing a platform from which the leading workers in atomic physics could speak.

The work of the Chemistry Section included a remarkable presidential address by Sir Harold Hartley on "Michael Faraday and the Theory of Electrolytic Conduction", in which he disclosed the unexpected array of historical material and linked this up with the most modern views on the nature of strong electrolytes. The discussion which followed included contributions from Debye, Bjerrum, Bronsted, Fajans, Philip, Guggenheim, Butler, Scatchard, Lange, McBan, and Lowry. This discussion alone was therefore comparable in

interest with the Faraday Society's general discussion on "Strong Electrolytes" at Oxford in 1927, although it was limited to a single day

The discussion on vitamins on the following day was in some respects even more remarkable, since the visitors who contributed to it must have come to England for this express purpose rather than for the associated physical celebrations. The discussion on vitamin A was introduced by Sir Frederick Gowland Hopkins, and was contributed to by Karrer, Euler, Morton, Heilbron, Richard Kuhn, Moore, and Drummond, while the contributors to the discussion on vitamin B included Jansen, Peters, Drummond, Callow, Windaus, Reerink and van Wijk, Heilbron and Simpson, the concluding review being contributed by Robinson

A symposium on "The British Fuel Problem", with reviews by Sir David Milne-Watson, Sir John Cadman, and Mr H T Tizard, provided a technical alternative to a discussion on the atomic weight of oxygen in Section A, and included contributions from Sir James Irvine and Prof W A Bone

The final discussion, on "The Structure of Simple Molecules", brought into the Chemistry Section many of the pioneers in atomic physics. The contributors to the discussion included Debye, Lennard-Jones, R H Fowler, Victor Henri, Heisenberg, Born, and W L Bragg

In view of the unique character of the programme, it would have been a serious loss not to preserve a permanent record of the work done by the Section. The record provided by the secretaries in the present volume includes all the valuable material contributed to the four discussions. It has been issued in a well-printed volume, comparable in size with the official report of the London meeting of the British Association, and is issued at such a remarkably low price that it should merit a very wide circulation amongst those who are interested in the progress of chemistry in its various aspects

### Short Reviews

*A Practical Handbook of Water Supply* By Dr Frank Dixey Pp xxviii+571 (London Thomas Murby and Co, 1931) 21s net

Few problems of immediate importance in the pioneer development of colonial territories are more urgent than the provision of an adequate water supply. Various geological surveys and irrigation departments give advice on particular schemes, but no book which would serve as a general guide has hitherto been available. Dr Dixey has realised the necessity for such a book as a result of his experience in Nyasaland, and those who are called upon to provide water supplies in

outlying regions owe him a deep debt of gratitude for the very practical and thoroughly competent treatise which he has been stimulated to write

Although the conditions particularly kept in mind are those characteristic of Central and East Africa, the book will prove helpful to workers in other similar regions, and not only so, but also to students of water-supply problems in general, for the geological, engineering, and other aspects of the composite problems involved are all dealt with in ample detail. Methods of dam construction and of sinking wells and bore-holes to moderate depths are described, with the view of helping settlers and administrative officers who are likely to be inexperienced in such work. Less attention is paid to the technique of deep boring, which must of necessity be carried out by experts. The various means of safeguarding against contamination and of purifying unsatisfactory supplies are surveyed in the very important chapter on the quality of water. One of the most interesting chapters is that devoted to water-finding methods. The desirability of a geological report before costly schemes are undertaken is rightly stressed. "Reliance upon any other advice, such as that based on water-divining, may lead to serious waste of time and money." The book concludes with an invaluable summary of the water-supply conditions in South Africa, the Rhodesias, Nyasaland, Tanganyika, Kenya and Uganda, the last of these having been contributed by Mr E J Wayland. There are several geological maps embodying information not otherwise easily accessible

The book will undoubtedly be of very great assistance to those for whom it has been primarily prepared, and much of it will appeal to a far wider audience

*Hydraulics for Engineers including Turbines and Pumps and Unsteady Motion* By Prof R W Angus Pp xii + 304 (London Sir Isaac Pitman and Sons, Ltd, 1931) 12s 6d net

In view of the rapid development of the exploitation of hydro-electric power in Canada and the United States, the subject of hydraulics is of outstanding importance to engineers in North America. A new textbook on the subject by the professor of mechanical engineering in the University of Toronto naturally, therefore, arouses interest as to the treatment accorded to the problems which present themselves in connexion with turbine installations. Including centrifugal pumps, Prof Angus devotes rather more than a third of his book to the consideration of this subject, and within this space gives an effective résumé of the conditions to be met and the calculations involved in design

Among several examples of typical installations, Prof Angus briefly describes the reaction turbines of the Conowingo plant on the Susquehanna River and the impulse turbines of the San Francisquito No 1 plant of the city of Los Angeles. The former, which has a present aggregate capacity of 378,000 horse power, is among the largest in the world, and one of its units is of greater size than any other at present in existence, having a discharge nearly



three times that of the 70,000 horse power turbines at Niagara Falls. This unit, a section of which is illustrated, develops 54,000 horse power under 89 ft head at a speed of 81.8 revolutions a minute. The Los Angeles runner, with a head of 870 ft, develops 32,200 horse power at 143 revolutions a minute, while another (also illustrated) at Big Creek, California, has a capacity of 56,000 horse power at 250 revolutions a minute, under a head of 2200 ft.

The first part of the book deals with the fundamental problems of flow of water in pipes and open channels, through orifices and over weirs, on lines which are fairly general, due prominence being given to the Francis formulæ for weirs and the Ganguillet-Kutter formula for open channels. The third and last part of the book is devoted to non-uniform flow. The type and diagrams are clear and distinct. Exercises are given, with numerical answers, and there is a serviceable index. B C

*Handbuch der Experimentalphysik* Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 11, Teil 3. *Elektrische Beleuchtung*, von Dr. Helmuth Schering, *Schwachstromtechnik*, von Prof. Dr. K. Kupfmüller. Pp. xiii + 501. (Leipzig: Akademische Verlagsgesellschaft m. b. H., 1931.) 46 gold marks.

THIS section of the handbook is divided into two parts. The first deals with electric lighting and its measurement, and the second with the techniques of weak currents, including telegraphy and telephony.

Prof. Schering discusses lighting mainly from the scientific point of view, but his results are immediately applicable in practice. Interesting diagrams are given of the energy emitted by substances at various temperatures and how this energy is divided up amongst the rays of different wave-lengths. For measuring mean spherical candle-power Russell's method is given. Apparently in Germany it is possible to buy polar paper divided up into the requisite angles, and this greatly shortens the time taken to make a measurement by this method. Useful data are given in connexion with the Hefner lamp, which has played such a great part in the history of photometry. A good discussion is given of projector lamps. The 'weak current' section of the volume is well done. It is clearly written, the diagrams can be understood at a glance, and it is not overburdened with mathematical equations. A description is given of cables suitable for long-distance transmission. The use of Pupin coils is described, and oscillograms are given to elucidate their action.

*Weeds in the Garden of Marriage*. By George Pitt-Rivers. Pp. xv + 86. (London: Noel Douglas, 1931.) 3s. 6d. net.

It perhaps might have been called more truly "Weeds in the Garden of Race Progress", for the very institution of marriage—as cultivated by Church and State—is one of the rankest weeds Mr. Pitt-Rivers finds. In his own words, his book is "a plea for a little more thinking", and it is backed by forcibly stated reasons for thinking as

he thinks, and for seeing with him that a thoughtful application of the principles of eugenics to our economic and race problems is our only salvation, that, in fact, we are subject to compulsory restriction of reproduction, and eugenics only proposes to change the method of restriction to sterilisation rather than taxation, and shift its operation from the healthy to the feeble.

Mr. Pitt-Rivers is intensely in earnest, for, as Sir Arthur Keith points out in his introduction, he sees disaster stealing upon us, and if he reads the signs of the times aright, there is nothing that can save us. He sees the race, indolent, ignorant, and vain, using its power of reproduction to destroy itself, not only permitting, but even encouraging feebleness and disease to live by mating with intelligence and health, and to send forth new polluted streams, vitalised by that mating. Better, he says, incest and inbreeding than this steady undermining of intelligence and health. Incest gave us Cleopatra, and it would emphasise not only the good qualities of healthy stock but also the defects of the feeble and diseased, until the latter would perish of sheer inanition.

Make the world safe for intelligence, is Mr. Pitt-Rivers' cry, and all good things will be added unto you.

*Creep of Metals*. By H. J. Tapsell. Pp. xiv + 285. (London: Oxford University Press, 1931.) 30s. net.

FOR many years the maximum stress has been regarded by the engineer as the main criterion by which to estimate the strength of a material in service. It is now realised, however, that above a certain temperature the strength may not be truly disclosed by the ordinary tensile test, and a stress, which is often very much less than that which this test would suggest, may result in failure if sufficient time be allowed. The process which brings about fracture is a comparatively slow deformation known as 'creep'. Following on the pioneer work of Chevenard and Dickenson, a very large amount of information has been accumulated on this subject during the past ten years. It is, however, very widely dispersed through engineering and other scientific literature, and the author has performed a most useful service in bringing it together. No phase of the subject has been overlooked and a difficult task has been performed with marked success.

It is clear that as yet little or nothing is known about the ultimate physical explanation of the phenomenon. But the time has now come when it is possible for the author to devote the last chapter of his book to a consideration of the bearing of the facts on the design of structures to operate at those high temperatures at which such effects are most pronounced. In view of the present position of the knowledge of creep, no more than the author has been able to accomplish could possibly be expected, and a most valuable addition has been made to the literature dealing with what is too often the 'no man's land' between metallurgy and engineering. F C T

### The British Association      Some Early Documents

**M**OST appropriately at the time of its centenary, the British Association came into possession of a collection of letters and other documents retained, and in part mounted in a book, by John Phillips, its first secretary. These were saved from destruction and generously presented to the Association by Prof W J Sollas, after they had been unearthed in the department of geology at Oxford, of which Phillips in later life became the head.

By far the most important letter historically is the first—that which Brewster wrote to Phillips in February 1831, proposing the establishment of a 'British Association of Men of Science', and a first meeting in York. The Association possessed until now only a copy of this letter. A large proportion of the letters are acceptances or refusals of invitations to that first meeting—one finds among them such signatures as Whewell, Buckland, Airy, J F W. Herschel, Scoresby, Rigaud, Baden Powell. There are several letters from Robison, who interested himself closely in the details of the arrangements. One observes anxiety as to whether the unsettled state of the country would make it expedient to postpone the inauguration of the Association until 1832—strange that both the birth and the centenary should have fallen in evil days. We have other letters from Brewster besides the first, one of which indicates that he forecast York, as a geographical centre, not only for the first meeting but also for the subsequent headquarters of the Association. We have the essential portion of the letter from Harvey of Plymouth—unfortunately lacking the signature—from which Vernon Harcourt in his foundation speech borrowed, with acknowledgment, the comparison of the objects of the Association with Bacon's 'circuits of divers principal cities' in the "New Atlantis".

An outspoken letter from J D Forbes refers to one received by him from Whewell, who "in mentioning Dr Brewster's attack upon Professors in their scientific character (which his best friends must allow to be unadvised and most unreasonable) adds that even if other circumstances permitted he should certainly not think of going to York, to rally under Dr Brewster's banners. Now this is truly too absurd. That Dr B originated it (*sic*) there can be no doubt however Mr Murchison has endeavoured to confine its origin to London and the Geological Society (and I must say he treated his countrymen rather cavalierly on the occasion)—but to suppose that on that account the Doctor was to take any ostensible charge, so that even if he did a mere party feeling should keep men who ought to be above such things, from joining in a scheme intended for the general promotion of Science in Great Britain, is really vexatious. I believe I mentioned to you that Dr B's nervousness in public is so great that even were he requested, he would be unable to act any conspicuous part at the Meeting. And it might nearly be considered the downfall of the Association, if the whole constellation of talent at

Trinity were thus to be withheld from fostering so infantile a project. I think you might devise some means for correcting the most erroneous views of the Cantabs." Forbes' pen was not prone to restraint, and there is a letter from Brewster to Phillips, quoting with pain some comments by Forbes, in writing to a third party, which injudiciously reflected upon Brewster's candidature for the chair of natural philosophy at Edinburgh, to which Forbes himself was afterwards appointed.

Perhaps the most attractive 'human document' of the collection is the MS report of a discussion on mineral veins, and other transactions, at the Cambridge meeting in 1833. The British Association has never been methodical in reporting its own discussions, and perhaps its reluctance, in earlier days at least, was not unwise, if this be a sample of a serious attempt at a report. Scientifically it is of little worth, save where John Phillips strikes out the reporter's version of his remarks and substitutes his own. The report starts, brightly, with the statement that "Mr John Taylor read a paper on the state of our knowledge with regard to metallic veins, of which not much was audible in consequence of that low tone in which he read and the noise at the other end of the senate house." Sedgwick, as president, was in the chair, and proceeded to summarise the previous speaker's views "as far as he had understood him." Taylor, he said, had referred metallic veins to three causes—"that they were injected from above, or forced up from below by convulsions of nature, or else were what was called contemporaneous, that is made by causes in nature always in operation." Sedgwick remarked that for the results of this last process Whewell ("who had a great penchant for etymology and had larded our language with many words of his own invention") had proposed the phrase "veins of segregation", whereupon Whewell, apparently at considerable length, said nothing in particular upon a topic which was scarcely his own, in justification of his new term, which seemed to find acceptance.

Buckland had previously considered Taylor's three causes, rejecting the first, admitting the second as possible, preferring the third. "He had however some fourth case which I have forgotten," says the reporter naively, "I think it was that of sublimation", and a note is pencilled in Phillips' hand "This was Dr Buckland's favourite theory, by this process he supposed nearly all cases of difficulty could be solved". Not so others. Murchison expressed the fear that Buckland's "brilliant harangue might have silenced some gentlemen present who, he knew, held opinions varying from those which that learned gentleman had expressed." Sedgwick thought some of the distinguished foreigners present might have something to say, and that they were welcome to say it in French if they wished. A pleasant passage follows.

"Mr Murchison. Mr President, I am commissioned by the foreign gentlemen whom you have called upon to speak—"

"President No, no, not called upon no one is called upon to speak—no one need speak unless they please

"Mr Murchison Very well, Mr President, then I am commissioned by the gentlemen whom you have not called upon to say that they are not at present prepared with arguments to refute Dr Buckland's theories but probably may wish to do so at some future time "

Dr Boase then stood forth, and began "in a very angry tone" by saying that he had "not been beaten down by Dr Buckland's speech", and Sedgwick and Murchison had both to assure him that they had never intended to suggest this (and indeed it was sufficiently obvious from what remains to us of the speaker's diatribe) Phillips then took up Whewell's theory of segregation, and by way of supporting it, remarked rather caustically that "he would venture to trespass so far on the attention of the meeting as to state the facts distinctly" One faintly conceives Whewell's own sentiments on hearing this, but the meeting now appears to have concluded peacefully.

The proceedings at the general meeting on the following day seem, however, to have been even less harmonious It opened, following a practice of the time, with reports of sectional transactions by appropriate representatives, and so far all was well Then Peacock read a paper on the analysis of algebra, amid a buzz of conversation which Sedgwick vainly attempted to check at last "the president requested that a constable should be sent up to stand by him", actually, "a servant" was procured Sedgwick by this time may have

been feeling the strain of his office he "observed that Professor Henslow had some proposal which he wished to make to the meeting and he had better speak for himself, as he considered that Professor Henslow knew his own intentions better than he, for he could not understand them at all" Poor Professor Henslow had nothing less innocent to propose than a botanical excursion "He believed the neighbourhood of Cambridge furnished little matter interesting to the geologist, or no doubt Professor Sedgwick would have been happy to—*Professor Sedgwick* Talk of your own affairs if you please, Professor Henslow, and do not interfere with my business" The upshot was that the president, *ex cathedra*, said in effect that the botanists could do as they liked, but if the geologists wanted an excursion, he would rather be excused

Certain further papers were given, including one by Rennie on hydraulics, "much too learned for common comprehension, and not well read" Finally, the president took the floor with a series of announcements, about "the ordinary", about a display of fireworks which "every member was invited to see and take with him a train of three ladies", about a recondite jest of Whewell's concerning waterworks in place of the fireworks, and at last "after several times calling the assemblage back to hear different announcements which he had forgotten, the meeting broke up for that day"

Such, we must suppose, is the earliest attempt to provide brighter reports of the meetings One suspects that the "Mudfog Papers" may have had some basis in reality.

### Physical Laboratories and Social Service \*

By SIR WILLIAM BRAGG, O.M., K.B.E., F.R.S

IN these days the services to be rendered by a physical laboratory become more definite than they were not more stereotyped, because the possibilities and modes of their usefulness are increasing, but more clearly understood With some curiosity I have read again an address which Lord Kelvin (then Sir William Thomson) gave at the opening of the physical and chemical laboratories at University College in Bangor in 1885 Thomson could then describe, as happenings of his own time, the beginnings of instruction in practical physics and chemistry and the construction of the necessary laboratories Soon after he went to Glasgow, in 1846, he was in need of help with some electrical measurements and invited the aid of students, which was willingly given Others heard that some of their fellows had got experimental work to do, and begged to be allowed to join in This was the beginning of practical work for the students in his laboratories Thomson recalled, with great zest, that three-quarters of his helpers were theological students, and that he had to explain to an amazed outsider that they seemed to be happy in their work and were getting on very well

At that time, of course, experimental science had already an accepted place, but there is a quaint evidence of a certain antagonism to it when he carefully explains that to measure the forms and properties of crystals is not to put them to an ignoble use

At that time, also, the Cavendish Laboratory at Cambridge had got well under way, there were laboratories in the London colleges and elsewhere But the number was small in comparison with that of to-day, when so many universities, colleges, schools, industrial firms, and other bodies have built and equipped laboratories, many of them magnificent in their equipments and their spaces The nation itself has felt the need, and in 1899 founded the National Physical Laboratory at Teddington, where, also, a National Chemical Laboratory has now been working for the last few years The research associations working in connexion with the Department of Scientific and Industrial Research have all their separate laboratories where physical and other research is carried on

There has, in fact, been a great change since Thomson made his Bangor speech, in the general estimate of what may and ought to be expected from the physical laboratory People are undoubtedly more interested in the growth of natural

\* From an address delivered at the opening of the new Physics Building of the University of Leeds on Feb 18

knowledge, and more aware of what it means to them. The manufacturer has discovered the possible, and often immediate, advantage of research; the politician observes that scientific discovery is a world force; the teacher and the thinker find that the unfolding of Nature's laws alters the lines on which they move, and many people of every kind ponder over what this continual advance in knowledge may imply.

Moreover, John Citizen is interested in yet another way. There was once a time when private liberality alone founded institutions of learning and provided for their maintenance. Universities, colleges, and schools still owe much to the generosity of their friends. But such institutions are also, in these democratic days, supported directly by the citizen by way of government grants, county grants, municipal grants, and by more widely spread contributions from individuals. Industrial laboratories and State laboratories, of course, are directly provided for by funds which are expected to be repaid in the form of contributions to the welfare of industries and of the community in general. John Citizen has not only become interested as a spectator, in the advance of knowledge by experiment; he has also begun to see its advantage to himself, and is willing to pay for it.

Physics might be thought to be one of the last of the sciences to feel this change of attitude, because it is one of the most fundamental, further away than the others from direct contact with everyday life. Much of modern physics has, of course, an appearance of remoteness. That is not only due to the nature of the subject, but also because various applications of physics have led to hiving-off processes. As soon as a branch of physics becomes useful, it ceases to be physics and begins a new life under another name, such as the various forms of engineering science, or meteorology, or cryogenic research. But there are few things more fascinating in scientific work than the unexpected application of some discovery, made in the progress of a research which seems to be out of touch with everyday things: it may take the form of an illumination of some common event, or a solution of a vexed question, or a welcome aid in some enterprise. Contact is continually being made between the abstruse and the obvious: we should scarcely expect otherwise if we are convinced of an all-embracing unity.

Thus a physical laboratory takes its recognised place of service to the community. What can it do now? How can it extend its service in the future?

First, of course, it exists for the instruction of the student. Many professions for which men and women are trained depend to a greater or lesser extent upon physical laws, which must be grasped and understood. Teaching by experiment can be made an instrument for most valuable training in accuracy, judgment, and the regard for unbiased opinion. Moreover, these young people go out into the world as exponents of ideas and principles which they have learnt to believe in. The great and useful influence which may proceed from a laboratory cannot, in general, be exerted directly: it

has to be disseminated through many channels. In the laboratory it is possible to teach what science is, and what it implies: lessons which are far from being learnt by the world at large. The British Broadcasting Corporation, in its useful, praiseworthy way of attacking the great questions of the day, has recently employed eminent thinkers and workers to speak on "Science and Civilisation." These discourses have been, it seems to me, of great benefit to the cause of science, and not least those which at first sight seem to be antagonistic: for their 'acid' has bitten, not into science itself, but into false conceptions of it, and has left the nobler metal clean and untouched. There are two notable errors which discussions such as these help to remove. One is to mistake mechanisation for science, and to ascribe certain evils to science which come from a wrong use of the machine—which are in truth, as Sir Oliver Lodge says, a blot, not on science, but on civilisation. Splendid truths can be put to evil purposes. The other of the errors to which I would refer is the use of scientific terms, conceptions, and facts in regions where they have no place. I do not mean only arguments about ethers, vibrations, influences, and the like, which few people take seriously; but there is a curious liking for risky extrapolation, for discussions of questions to which experimental science is not yet ready, possibly never will be ready, to give an answer, for argument by analogy, which is dangerous.

A laboratory exists also for the increase of natural knowledge by experiment: and none more obviously so than the laboratory of a university. Of necessity, the most fundamental and valuable research must be done—not as being useless, as some exaggerations would have it—but without regard to the nature, or even the possibility of its use, which is obvious enough. I need not elaborate this vital point: it is well understood.

Of recent years the encouragement of industrial research has led to the establishment of a number of laboratories attached to various industries, and dealing mainly with the physical and chemical problems that industry encounters. These are supplied with men mainly trained in university laboratories. The Department of Scientific and Industrial Research makes a number of grants each year to men working in university laboratories in order that they may be enabled to train themselves for industrial research posts. It is for the university laboratory to encourage and help those who avail themselves of these grants. The university laboratory should be in touch with the surrounding research associations, thus keeping contact between pure science and its special adaptations.

It is possible that there is yet another way in which the laboratory may be of service. I mention it rather as a provocative suggestion than as an actual recommendation. Is it not possible to see more of John Citizen himself in the laboratory? Of late years the science museum has advanced in popularity and usefulness by leaps and bounds. It is far more up-to-date in its exhibits, far more interesting in its displays. The well-organised Science Museum in South Kensington is visited by

far more than a million people a year. A huge museum is in course of erection in Philadelphia. The great museum in Munich is famous. It is, by the way, interesting that this pioneering institution should have been founded in the city where Count Rumford served the State of Bavaria so notably. For it was he who conceived the idea of the science museum and wrote elaborately on its objects and its management. This was a hundred and thirty years ago: and it could not be improved upon now. The Royal Institution was founded in the attempt to give form to his ideas. It failed to do so because the times were not ripe; but that is no longer the case. The Faraday Exhibition of last September drew fifty thousand visitors in the ten days of its activity. I had occasion recently to visit a smaller but similar exhibition arranged in the new laboratories at Exeter; five thousand people visited it in two or three days. The public has not only a newly awakened interest in science, but also is delighted to see actual demonstrations. This is all the better because so much of the interest has been excited by written description or by talks over the ether, and the visible example is much needed as a corrective.

Such exhibitions are of proved value, and may be extremely useful under the conditions of to-day. If any effort were made to follow examples set elsewhere, to demonstrate visually to John Citizen the slow unfolding of Nature's laws by patient research, the discovery of unsuspected beauties of order and adaptation, the origin of new conceptions of the universe, and, not least, the skilful handling of new knowledge for the service and delight of man, then the university laboratories would naturally be looked to for help. To them it would fall, as it fell to the Royal Institution, to illustrate particularly the development of scientific ideas and methods.

We cannot ask that everyone shall be trained to understand and follow the advance of scientific knowledge. All that can be worked for—and it is far from our present attainment—is that there shall be an understanding of what science is, of what it can do, and of what it cannot do. Even this cannot be expected from the public as a whole: but it is urgently necessary in these days that a sufficient number shall be so informed, and especially those whose collective opinions and wishes determine the general courses of action.

### Clouds High in the Stratosphere

By Prof. S. CHAPMAN, F.R.S.

THREE years ago, Prof. C. Størmer, of Oslo, made a preliminary announcement in NATURE of photographic observations by himself and his assistants upon the height and colour-distribution of some clouds at a remarkably great height in the atmosphere nearly over Oslo.<sup>1</sup> He has now issued a detailed account of this work,<sup>2</sup> and also of some hitherto unpublished visual observations on similar clouds, made by him on Jan. 1 and Jan. 15, 1890. The memoir is very fully illustrated by 140 diagrams and eleven beautiful photographs, three of which are reproduced herewith.

The clouds were of the type termed in English iridescent; in German, the language in which Prof. Størmer's memoir is written, they are called *Perlmutterwolken* (mother-of-pearl clouds). The simile appears to be an apt one for the more luminous parts of the clouds, which present one of the most beautiful spectacles afforded by the sky. The colours and colour changes observed in these clouds are stated to be "essentially different" from the ordinary iridescence often seen at the edges of thin clouds near the sun. They are also very different from the bluish whiteness of the luminous night clouds, at about 80 km. height according to Jesse, which Størmer states have often been seen by him. Very detailed descriptions are given as to the changing colour distribution of the clouds, especially for those of January 1890; the colours are mainly arranged in bands following the outlines of the clouds, and these bands, and the outlines, in some cases change rapidly, so that before a sketch of them is completed the earlier part of the sketch no longer represents the form of that section of the cloud.

Apart from their extreme beauty, the clouds

are distinguished for their great height; this was suspected by the late Prof. H. Mohn, who specially studied these clouds, but it was first definitely confirmed by Prof. Størmer in 1927, who was able, on Dec. 30, 1926, to take two pairs of simultaneous photographs of such clouds from his auroral stations at Oslo and Oskarsborg. The height found was between 26 km. and 30 km. The new photographic material for the clouds of Jan. 13, 1929, is much more ample, the number of pairs of photographs exceeding ninety. The heights then found lie between 23 km. and 26 km. The existence of clouds at this high level had never previously been established. Ordinary clouds are almost entirely confined to the troposphere, that is, below about 10 km. These mother-of-pearl clouds are high up in the stratosphere.

Yet another peculiarity of these clouds is their rarity; Prof. Størmer saw them in 1890, but from 1892 until the end of 1926, though carefully watching for them, he failed to find any. In 1929 he again saw them. The conditions under which they were seen were similar in the three cases, and agreed with those described by Mohn, as associated with nearly all his observations of the clouds. They occur when there is a deep barometric depression near Oslo, and usually to the north; owing to the distribution of the mountains in the adjacent region, warm dry winds (Föhn) then often blow down the southerly and easterly slopes towards Oslo, and produce high temperatures, and a clear sky, over a part of the cyclonic area which is usually overclouded. Hence Størmer suggests that the high clouds may in fact be common features in the stratosphere over the ascending part of cyclones, but usually invisible. If this





FIG. 1.—Iridescent clouds to the west-north-west, after sunset on Jan. 13, 1929.



FIG. 2.—Iridescent clouds to the west-south-west, on Jan. 13, 1929.



suggestion could be tested by aeroplane observations above the clouds during cyclones (though this may offer great difficulty) it would be of great interest.

Visual observations of the clouds seen in December 1926 indicated the very high velocity of 75 metres a second (170 miles an hour). Those of January 1929 were nearly stationary, though near the ground there was a strong north-westerly wind; "the mother-of-pearl clouds lay over Ostland [a district near Oslo] for a time longer than that needed by the lower air to travel from southern Norway to Germany". Those of January 1890 seemed to be nearly stationary as a whole,

a second, during the  $1\frac{1}{4}$  hours of duration. If this be interpreted as their steady rate of fall subject only to gravity and the resistance of stationary air, it enables the size of the cloud particles to be estimated roughly, assuming that they have the density of water and are spherical. Applying Stokes's formula, the result is 0.005 cm. radius, but this value is near the upper limit for which, in these circumstances, Stokes's formula is applicable. The radius of ordinary cloud particles is about 0.001 cm. It is, of course, uncertain whether the substance forming the mother-of-pearl clouds is water, though it is difficult to see what else it could be. Iridescence is currently interpreted as



FIG. 3.—Iridescent clouds to the south-west, on Jan. 13, 1929.

but, like those of 1929 (though in a higher degree), they showed rapid internal motion, constantly breaking up or changing their shape. This is of interest as tending to confirm the view that convection or eddying motion does not cease at the top of the troposphere, but may extend far up into the stratosphere, at least to a sufficient degree to maintain a uniform mixture of the permanent constituents of the air up to a considerable height. Hitherto the most direct support for this idea has been the distorted meteor trails sometimes observed, generally at greater heights than 30 km. Prof. Størmer's observations on these high clouds of 1890 seem to afford valuable independent confirmation of this view.

The photographs of one small cloud, of January 1929, indicate a slow velocity of descent, of 30 cm.

indicating the presence of supercooled waterdrops.

The physical implications of the presence of these clouds at their considerable height in the stratosphere are, and for some time may remain, obscure; but possibly they will play a significant part, along with such other remarkable facts as those of the ozone relations with surface weather, in unravelling the mysterious and important problem of the origin of cyclones. However this may prove, Prof. Størmer is to be congratulated on this new achievement in precise upper atmospheric investigation, an interesting and important by-product of the organisation he has built up for the study of the aurora borealis.

<sup>1</sup> NATURE, 123, 260, Feb. 16, 1929.

<sup>2</sup> *Geofysiske Publikasjoner*, vol. 9, No. 4, Oslo, 1932; 27 pp. and 16 plates; 7.00 kr.

## News and Views

**Bicentenary of David Rittenhouse**

ON April 8 occurs the bicentenary of the birth of David Rittenhouse, the American astronomer, who has been described as "a true product of American genius and toil, and the highest embodiment of the pioneer spirit in science during the colonial period". The eldest son and the third child in the family of a farmer of Norriton, about twenty miles from Philadelphia, as a boy he began work on the land, but the gift of some tools and mathematical books stimulated his interest in mechanics and science. While still a youth he set up as a clockmaker, and at twenty was studying Newton's "Principia". Though in after years he devoted much time to mathematics and physics, his first important work was in astronomy. He made the first transit instrument and the first orrery constructed in America, in 1768 began the erection of an observatory at Norriton, and the following year took a prominent part in observing the transit of Venus. One of the earliest members of the American Philosophical Society, he contributed nineteen papers to its *Transactions*, in 1775 he delivered an oration on the history of astronomy, and, on Franklin's death in 1790, was chosen president. From 1777 until 1789 he was treasurer of the State of Pennsylvania, and from 1792 until 1795 master of the Mint of the United States. He received honorary degrees from Harvard, Princeton, and Pennsylvania Colleges, and in 1795 was elected a fellow of the Royal Society. His death took place in Philadelphia on June 26, 1796, and he was buried in the Presbyterian churchyard in that city.

**Dr. N. E. Brown**

THE University of the Witwatersrand, Johannesburg, has conferred the honorary degree of D.Sc. on Mr. N. E. Brown, formerly assistant in the Royal Botanic Gardens, Kew, in recognition of his work on the South African flora. At the request of the Moss professor of botany in the University, and to mark the conferment of the degree, Sir Arthur Hill formally presented Dr. Brown to his old colleagues in the Herbarium of the Royal Botanic Gardens, Kew, on March 19. In the course of a short address, Sir Arthur said: "Dr. Brown was on our staff for forty-one years, from 1873 until 1914. He was elected an associate of the Linnean Society in 1879, and in 1921 he received the Senior Captain Scott Medal for scientific research in South Africa from the South African Biological Society. I need not detail his many contributions to South African botany, as they are so well known to all botanists, but it is interesting to record that the following eminent South African botanists warmly supported the proposal that Dr. Brown should be honoured by South Africa: Gen. the Right. Hon. J. C. Smuts, Dr. I. B. Pole Evans, Prof. J. W. Bews, Prof. R. S. Adamson, Prof. R. H. Compton, and Dr. John Muir."

**Taxation of Imported Books in Australia**

As recorded in NATURE of Feb. 20, p. 271, a deputation representative of national libraries, universities, professional institutions in Australia and the Council

for Scientific and Industrial Research waited on the new Prime Minister, Mr. Lyons, early in February and pleaded for remission of the emergency taxation on imported books imposed by the late Labour Government. The revenue from this source in the current financial year ending on June 30 is estimated at about £75,000 from primage tax and £55,000 from sales tax. It was urged that the continuation of these taxes would result in a far greater loss in efficiency to the whole community than a loss of £130,000 would represent to the Government. Book prices are now so high that students are being forced to cease purchasing technical works and to rely more on libraries; but, unfortunately, the libraries are failing them. That in Sydney, for example, was obliged recently to cease its subscriptions to no less than 100 journals, and in the near future it is feared that a further 150 will have to be sacrificed. Other striking examples of the unhappy results of this taxation were quoted. Mr. Lyons, in reply, agreed with all the main contentions of the deputation, and offered slight relief in cases of exchange publications and certain historical materials for libraries. For the rest, he frankly pointed to the disquieting financial position of the Commonwealth and asserted that attainment of budgetary equilibrium is the only hope for universities, scientific societies, and the whole country. The book tax revenue must remain for the present. Sheer necessity is driving the Government to this unfortunate device, and to others also, which admittedly and inevitably will to some extent undermine the efficiency of the nation. Such a reply, while quite understandable, leaves a serious problem to be faced by educational and scientific organisations in Australia.

**New Emulsion Sensitive to the Infra-red**

FOR some time past, photographic materials sensitive to radiation between 7000 Å. and 9000 Å. have been available. The sensitivity of these plates has, however, not been high. The Ilford Company has now produced a plate which possesses a comparatively high sensitivity for this region of the spectrum. With a subject illuminated by two 1500-watt gas-filled lamps at a distance of about eight feet and screened by filters cutting off radiation of shorter wave-length than 7000 Å., the exposure is about half a second with the lens working at *f*. 4. Such photographs, taken in the dark, serve as an excellent demonstration of the existence of invisible radiation; the public, already accustomed to the idea of ultra-violet rays, thus becomes familiar with the infra-red. The practical use of these plates is, however, considerably greater than that of demonstrating the actinic power of the infra-red: in astronomical and geographical recording, their power to respond to the unscattered radiation coming through mist and haze from very distant objects makes them particularly valuable.

**The Sherman Hoyt Cactus House, Kew Gardens**

THE outstanding feature of the Royal Horticultural Society's Show at Chelsea in May 1929 was the



exhibit of cacti and other succulent plants which was shown by Mrs A Sherman Hoyt, of Pasadena, California. The collection of living plants was arranged against a painted scene of the Mohave Desert, and the whole exhibit was a presentation of the desert flora of Southern California. At the close of the Show, Mrs Sherman Hoyt very generously presented the collection of living plants to Kew, together with the painted desert scene and the rock and sand which she had brought over from California. Since it was impossible to make an adequate display of her exhibit or to make use of the very beautiful painting in any of the houses at Kew, Mrs Sherman Hoyt most generously offered to build a special house for the display of her plants with the background. In the house, now completed and planted, the desert scene occupies the semi-circular wall of the apse, and in the foreground is a representation of the desert in conformity with the painted background. The stone which has been used for building up the foreground is old red sandstone from Dunster, Somerset, and matches remarkably closely both in colour and structure the Californian rocks shown in the picture. Cacti and other succulent plants have been placed among the rocks in positions as near as possible to those in which they are found in their native home, and the whole effect makes a remarkably striking picture, since the rocky foreground blends so naturally with the painted desert scene behind that it is by no means easy to detect any break between the actual living plants and those shown in the background. The house was opened to the public on March 24.

#### India and Babylonia

THE discoveries at Tell Asmar (Eshnunnu or Ash-nunnak), announced by Dr H Frankfort in his letter to the *Times* of March 26, constitute an addition of no little importance to the evidence linking up the early civilisations of Mesopotamia and the Indus valley, especially if his conjectural relation of the new finds to the culture of Mohenjo Daro should be confirmed by subsequent investigation. The excavations of the Oriental Institute of Chicago on the site of private houses of the age of the Dynasty of Akkad (c 2550 B C) on the northern outskirts of the Tell have brought to light two seals, of which the character points unquestionably to an Indian origin. One, a cylinder seal, shows a design of a procession of animals, elephants and rhinoceros with crocodiles, which in subject and convention is both alien to Mesopotamia and referable to the Indus civilisation, while the second is of more common Indian form, a square stamp seal with a pierced knob on the back, and bearing a design of concentric squares which does not appear elsewhere in Mesopotamia, but occurs on similar seals at Mohenjo Daro. Further evidence pointing in the same direction has been found in the form of etched carnelian beads resembling Indian specimens, kidney-shaped inlays of bone identical in shape with some in shell from Mohenjo Daro, and two sherds of pottery showing a decoration with knobs, unknown in Mesopotamia, but also occurring at Mohenjo Daro. Certain distinctive features in the seals, however, lead Dr Frankfort

to think that either they belong to a slightly earlier or later phase of Indian civilisation than that at Mohenjo Daro or they may have come from another site within the same cultural area, the latter alternative being the more probable.

#### Bird-ringing in Great Britain

THE banding or ringing of birds is now accepted as the established technique for elucidating migratory and other movements, and Mr H F Witherby and the *British Birds* scheme are to be congratulated upon the success with which they have kept the system alive and increasingly flourishing in the British Isles. During 1931, more British birds than ever were marked with identification rings, 29,554, and this brings the grand total since the beginning of the scheme in 1909 to 316,955 (*British Birds*, March 1932, p 286). Recoveries vary greatly amongst the different species: the highest percentages are shared by two birds of prey, the peregrine falcon (23.3 per cent) and the merlin (21.8 per cent), and these figures suggest the intensity of destruction which overtakes such birds at the hands of game-preservers, for even the innocent kestrel is represented by 49 returns out of 494 ringed. At the other end of the scale stands the blackcap, the 517 ringed individuals of which gave not a single return, and for all the warblers and even many of the finches the recoveries are very meagre. Of 496 nightingales only 2 have been handled again, and of 507 arctic terns only one. It is obvious that a great deal of labour goes unrewarded in ringing birds, 22,943 swallows have yielded only 163 (0.7 per cent) returns, but the returns have brought out new facts regarding the range of the southward migration and the return of the birds to the locality of their birth. More curious still, of 37,225 song-thrushes, only 481 or 1.4 per cent have been found again.

#### The Nature of Carpels

IN a preliminary notice (*Bull. Classe des Sci. (Acad. Roy. de Belgique)* 5<sup>e</sup> Série, tome 17, 1931), Grégoire has criticised the view of the foliar nature of carpels, and in a fuller treatise he proposes also to extend the argument to the comparison of stamens with leaves, and, in fact, of the flower with a vegetative bud. His criticism is based on ontogeny, he points out that when carpels are formed, they do not appear as lateral structures on the floral axis, and the apex of the latter can never be recognised as still persistent in the centre of the flower. Further, he considers that the margins of the carpellary upgrowths do not meet and fuse marginally as is usually supposed, but are merely the appearances due to the upward extensions of a split in the tissues of the lower part, as this expands to form the cavity of the ovary. Most botanists agree, however, that the comparative morphology of vegetative and reproductive shoots supports the general view of the homology of vegetative bud and flower, but the changed type of growth has so altered the floral parts that, the nearer one passes towards the centre of the flower, the more difficult does it become to press detailed comparisons.

### Cultivation of Bulbs

DURING recent years, bulbs have become a field crop of considerable importance, especially in the Scilly Isles, Cornwall, and Lincolnshire, and growers, or intending growers, will welcome the illustrated bulletin No 44, entitled "Narcissi Culture", recently issued by the Ministry of Agriculture (H M Stationery Office, 9d). Although bulbs grow well on a number of soils, good drainage and cultivation are essential, but the direct application of fresh manure should be avoided. Potatoes which have been adequately manured leave the soil in excellent condition for bulbs. Among some of the more important questions upon which advice is given are those relating to grading, lifting, storage, and planting. Eelworm has become a serious menace to the bulb-grower, and sterilisation by means of hot water (three hours' immersion at 110° F) is strongly advocated, the treatment being given when the bulbs are in as dormant a condition as possible, or injury may result. As regards flowers, while good grading, bunching, and packing are essential, the importance of making the flowers look attractive by means of details such as packing-paper should not be overlooked. Although this trade in narcissus flowers has increased so enormously, the allied bulb-growing industry could become one of even greater financial importance, for the sum spent annually on imported bulbs amounts to nearly £1,500,000.

### Manures and Manuring

It is recognised that owing to the variation in local conditions, it is impossible to give a complete guide to manuring on every farm. Still, the information supplied in *Bulletin* No 36, entitled "Manures and Manuring", which has recently been issued by the Ministry of Agriculture to replace the sectional volume of *Leaflets* No 8 on the same subject, the text having been considerably revised by Mr H. V. Garner (H M Stationery Office, price 1s 3d net), should be of the utmost value to farmers, if they are to derive the fullest benefit from the money spent on fertilisers. The *Bulletin* is divided into three parts, the first of which deals with organic manures. In spite of the recent great development in artificial fertilisers, farmyard manure is still the stand-by of arable farmers, but although it is by far the most important type of organic manure, the value of other materials such as liquid manure, town refuse, poultry manure, and seaweed is evidently considerable. Part II is devoted to artificial fertilisers. The various types of nitrogenous, phosphatic, and potash manures now on the market are described, while a further section deals with the use of compound manures. The third part supplies useful information with regard to the purchase and use of artificial fertilisers, and enables the farmer to determine the comparative value and costs of nitrogen, phosphoric acid, and potash in the different forms without difficulty. Some suggestions are made, on quite general lines, as to the treatment of farm crops, and a further section is devoted to a discussion of soil analysis and its bearing on cropping and manuring.

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### Improvements in Epidiascopes

RECENT developments in the design of instruments for the projection of opaque objects have been directed towards increasing the intensity of light directed on the object, improving the quality of the projection lens, and simplifying the mechanical construction in order to ensure lightness, durability, and ease of manipulation. An active part in the development and perfecting of such instruments has been taken by Messrs Newton and Co of 72 Wigmore Street, London, W1. Since the production of their first episcopes in 1916, the efficiency and convenience of succeeding models have increased with each stage of development. The high efficiency of their latest types is due largely to the use of special diffusion reflectors. The illuminant is a single 500-watt gas-filled lamp which is so placed that four of these reflectors can be used to concentrate the light on the object and give a uniform illumination over the whole field, an area 6 in x 6 in. This arrangement, combined with a large aperture projection lens, provides an illumination on the screen equal to that obtained from earlier instruments employing two lamps. As only one lamp is used and the lamp-house well ventilated, the objects are not exposed to any great heat. When it is necessary to keep them at room temperature a ventilating fan can easily be fitted. The silver-surfaced reversing mirror is mounted outside the lamp-house and, consequently, is not subjected to heating from the lamp. The construction of the body, which is of cast aluminium, is such as to ensure lightness and durability, and the design of the instrument renders its operation extremely simple. Precise and easy adjustments are provided for all necessary movements. Instruments of different sizes, embodying these improvements, are available with working distances ranging from 16 ft. to 40 ft.

### Electrical Conveyors in Mines

It is generally admitted that the only real way to increase the prosperity of a coal mine is to increase the output per head of the workers employed. Of recent years great improvements have been made in the methods of the removal of the coal broken at the working face by mechanical conveyors actuated by electric motors. The Metropolitan-Vickers Electrical Company has specialised in the production of motors and control gear for this purpose. In the December issue of the firm's *Gazette*, an account is given of the many rigorous conditions these motors have to satisfy and the various types of conveyor used in practice. In the belt conveyor the coal is carried on a moving continuous belt. In the shaker conveyor it is conveyed by an oscillating trough, which moves slowly in one direction but has a comparatively quick return. The coal is thus carried forward in the desired direction by a series of jerks. In the scraper conveyor the coal is conveyed by a continuous scraper working in a fixed trough. For each type of conveyor the demands on the electrical motor are different and so also are the arrangements of the electrical control equipment. Graphs are given, showing how the loads on these types

of conveyor vary with the time. In the motors ordinarily used, causes of failure arise from the whipping of the shaft and from the ingress of stone dust at the bearings. In the motors described, the roller-bearing at the driving end and the ball-bearing at the opposite end are both constructed in dust-proof ' housings '. The diameter of the shaft of a Metropolitan-Vickers new 15-h p. conveyor motor is 2.5 in. and the rotating part is practically indestructible. The progress made in mechanical haulage will greatly diminish the use of animals underground for haulage purposes.

#### British High-Speed Aircraft

THE Aeronautical Research Committee has recently issued a résumé of the original scientific work done by various authorities in Great Britain upon the development of racing seaplanes, which has led finally to the winning outright of the Schneider Trophy and the breaking of the world's speed record during September 1931 (*Reports and Memoranda*, No. 1300 "Collected Reports on British High Speed Aircraft for the 1927 Schneider Trophy Contest", by W. L. Cowley. London: H.M. Stationery Office). This is a departure from the normal procedure of issuing information in disconnected reports and memoranda as it becomes available, which has the advantage that it becomes virtually a textbook upon its subject and saves the labour necessary in hunting up such information when issued in separate pamphlets. On the other hand, if it is necessary to wait for more than four years for the collection and collation of such information, the advantage of its more convenient method of issue is largely outweighed by the obsolescence of its material. The subject matter is divided into separate headings of research, specifications, design and construction, inspection and test, and operational. It deals in great detail with three machines that are widely different in characteristics regarded from the point of view of high speed flight. The monoplane versus biplane, and the air-cooled versus water-cooled engine controversy is thoroughly fought out with representative machines of each class. The most significant thing about the report is the agreement between scientific prediction and actual results, and the ability of scientific investigation to explain apparent phenomena arising during practical use of the aircraft.

#### Nickel in Marine Engineering

THE January issue of the *Transactions of the Institute of Marine Engineers* contains, as usual, a selection of important articles from the technical press, and a report of a paper on "Nickel and Nickel Alloys in Marine Engineering", read to the Institute by Mr. J. McNeil on Dec. 8. Of all the many uses to which nickel has been put aboard ship, none has proved more valuable than when alloyed with copper for condenser tubes. For a very long period, the deterioration of brass condenser tubes, with its accompanying trouble through leakage of sea water, has been a very serious problem, especially in ships fitted with water-tube boilers, but it appears to have been solved at last by the use of an alloy of 70 per cent copper and 30 per

cent nickel for the tubes. Alloyed with both ferrous or non-ferrous metals, nickel is used for steam turbine blades and nozzles, high-pressure steam valves and fittings, propellers, pistons and liners of Diesel engines, reduction gear wheels, and even crankshafts. Recently a process has been evolved in which nickel can be deposited in thick layers and thus worn parts built up. There is remarkable adhesion between steel and deposited nickel, and the resistance to shear of a thick ring of nickel deposited on steel is stated to be practically that of the metal itself.

#### Arctic Exploration

MUCH activity in polar exploration during the last year, particularly in Greenland and Northern Land and adjacent islands, is noted in the *Polar Record* for January. When Nansen crossed Greenland in 1888, the journey was considered to be difficult and adventurous. Since that date several other crossings have been made, but no period has been so fruitful in the exploration of the ice sheet as 1930 and 1931. During that time, two observatories have been instituted and used for longer or shorter periods on the ice, including the German station of the Wegener expedition in the centre, three new crossings of the ice-sheet have been made, including one across the greatest width, and for the first time, echo measurements of the thickness of the ice have been taken. It is also noted that Soviet explorers from the station on the Kamenev Islands to the west of Northern Land, in long sledge journeys, have filled in the western coasts of that land and determined its northern extremity in lat. 83° 16' N, long. 95° 37' E, thus finishing the last piece of pioneer work that the arctic regions offered. Details of these and various other polar explorations are given in the journal.

#### The Malabar District of India

A SERIES of articles on the Malabar district of India is published in an enlarged number of the *Journal of the Madras Geographical Association* (Oct. 1931-Jan. 1932). These papers were read at a conference of the Association held at Palghat in May 1931. They cover the geology, meteorology, botany, and agriculture of the district, and are illustrated by various maps. Following these there are other papers dealing with modern and ancient trade, trade routes, and urban centres. A particularly interesting paper treats of Roman trade centres on the Malabar coast. There are also notes on the place names. The volume is a useful contribution to the study of India, and is chiefly the work of Indian teachers.

#### Tours in the U.S.S.R.

IN 1931 the Society for Cultural Relations arranged two conducted tours to demonstrate present activities in science and medicine in the U.S.S.R. Similar tours, each lasting about a month, are being organised this year between July 15 and Sept. 15. It is hoped to arrange parties for physicists, biologists, medical men, and others, each party being limited to about twenty persons. Travelling arrangements will be made by Intourist, Ltd., Bush House, Aldwych, W.C.2, and

competent guides and interpreters will be provided by "Voks", the Soviet organisation for cultural relations with foreign countries. Full particulars can be obtained from the Society for Cultural Relations, 1 Montague Street, London, W C 1

#### Royal Institute of Public Health

THE annual Congress of the Royal Institute of Public Health will be held in Belfast on May 10-15, under the presidency of the Marquess of Londonderry. The Congress will be divided into the following Sections: I, State Medicine and Municipal Hygiene, II, Industrial Hygiene, III, Women and Children and the Public Health, IV, Tuberculosis, V, Pathology, Bacteriology, and Biochemistry. The inaugural meeting will be held in the Great Hall of Queen's University, at 11 A.M. on May 10, when the presidential address will be delivered. Several general excursions have been arranged, besides sectional visits to hospitals, sanatoria, etc., and certain institutions, centres, and works will be open for inspection. Further information can be obtained on application to the Secretary, Royal Institute of Public Health, 37 Russell Square, London, W C 1

#### Anti-Malarial Measures

SIR MALCOLM WATSON stated at a meeting held in January of the Industrial Anti-Malarial Advisory Committee of the Ross Institute for Tropical Diseases that while Paris green has a place in malaria control, it is not a substitute for oiling surface waters that breed mosquitoes, for the female can safely lay its eggs in water treated with Paris green, but is killed by water that has been oiled. The nature of the crude oil forming the basis of anti-malarial oiling mixtures has an important bearing on efficiency, and Dr Ramsay, in association with the Burma Shell Group, has completed researches upon the oils best suited for such mixtures.

#### Joint Archaeological Expedition to Antioch

ARRANGEMENTS have been made, we learn from Science Service, Washington, D.C., between Princeton University, New Jersey, and the Musée National of France, the Baltimore Museum of Art, and the Worcester Art Museum, for a joint expedition of excavation at Antioch. A five-year programme of excavation has been arranged. Prof. George W. Elderkin, of Princeton, is leaving immediately for Antioch to initiate the work. It is expected that it will be possible to excavate this ancient city without any disturbance of existing buildings.

#### Announcements

WE much regret to announce the death, on March 26, at the age of seventy-seven years, of the Right Hon. Sir Horace Plunkett, K.C.V.O., F.R.S., first vice-president of the Department of Agriculture and Technical Instruction for Ireland and a pioneer in the organisation and development of Irish agriculture.

At the March meeting of the Council of the Institute of Actuaries, Mr. W. Palin Elderton was elected president to succeed Mr. H. M. Trouncer, whose term of office expires in June.

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MR. ALDOUS HUXLEY will deliver the Huxley Memorial Lecture at the Imperial College of Science and Technology, South Kensington, London, S.W. 7, on May 4, at 5.30 P.M. The subject of the lecture will be "Huxley as a Literary Man."

At the annual business meeting of the Royal Philosophical Society of Glasgow, held on March 23, the following officers were elected: *Vice-President*, Dr. Henry L. G. Leask, *Hon. Librarian*, Dr. James Knight, *Hon. Treasurer*, Sir John Mann, *Secretary*, Mr. John A. Buyers, *Members of Council*, Mr. John P. Heshin, Miss M. A. Hannan Watson, and Mr. George B. Wishart.

LORD WAKEFIELD has given a sum of £25,000, spread over seven years, as a contribution to the Imperial Institute. The Institute is financed by annual grants from the Treasury, the Dominions, India, and the Colonies, and was faced with the prospect of curtailment of its activities, owing to temporary reduction of some of its supporting grants. It is hoped that Lord Wakefield's gift will enable the Imperial Institute to tide over the period of difficulty.

A COURSE of three public lectures on "The Role of Statistical Method in Industrial Standardisation" will be given by Dr. W. A. Shewhart at University College, Gower Street, London, W.C. 1, on May 3, 5, and 6, at 5.30 P.M. Dr. Shewhart is a member of the technical staff of the Bell Telephone Laboratories, New York, and in these lectures an attempt will be made to outline the present status of the applications of modern statistics. A syllabus of the lectures may be obtained on application to the Academic Registrar, University of London, South Kensington, London, S.W. 7.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A public librarian under the Colwyn Bay Urban District Council—The Clerk to the Urban District Council, Council Offices, Colwyn Bay (April 14). An assistant curator in the Royal Botanic Gardens, Kew, in charge of the Decorative Department—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W. 1 (April 15). A mathematical master at the Royal Naval College, Dartmouth—The Headmaster, Royal Naval College, Dartmouth (April 18). A professor of philosophy at Armstrong College—The Registrar, Armstrong College, Newcastle-upon-Tyne (April 20). An assistant in the Natural History Department of the University of Aberdeen—The Secretary, University, Aberdeen (April 20). A reader in chemical engineering at the Imperial College (Royal College of Science)—The Academic Registrar, University of London, South Kensington, S.W. 7 (April 22). A professor of zoology at Armstrong College and director of the Dove Marine Laboratory—The Registrar, Armstrong College, Newcastle-upon-Tyne (April 23). A whole-time radiologist at the Johannesburg Hospital—The Superintendent, Johannesburg Hospital, Johannesburg, South Africa (May 25). A male laboratory assistant at the Government Experimental Station, Porton—The Commandant, Experimental Station, Porton, near Salisbury.



## Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

## Atoms and Molecules as Fitzgerald Oscillators

ACCORDING to the theory of the Raman effect, the depolarisation  $\rho$  of the Raman lines in gases and liquids should, when observed at right angles to the natural incident light, never exceed the value  $\rho = 6/7$ . Whilst values of  $\rho \geq 1$ , which have frequently been observed, could be ascribed to observational errors, a value of  $\rho = 2$ , which has been estimated by Bhagavantam<sup>1</sup> for one line of liquid sulphur trioxide, called for a further investigation. I have carried out this work,<sup>2</sup> using polarised incident light with the electric vector perpendicular to the plane through the light source, scattering object and observer. Denoting by  $\sigma$  the depolarisation for this mode of observation, there exists between  $\sigma$  and  $\rho$  the relation

$$\sigma = \frac{\rho}{2 - \rho}$$

It is clear, that, whilst the theoretical limit for  $\sigma$  is  $3/4$ , one should get  $\sigma = \infty$  in the case cited by Bhagavantam. This was clearly disproved by the experiment, which gave a value of  $\sigma$  not exceeding unity.

Sir C. V. Raman has lately made<sup>3</sup> the very original suggestion that the observed values of  $\rho > 6/7$  might be explained theoretically by assuming that the scattering molecules behave as magnetic dipoles. If this be the case, it is the magnetic vector in the incident light which gives rise to the Raman line, consequently the above-mentioned experiment must be repeated with the incident light polarised at right angles to that used formerly. For  $\sigma$  one now has  $\infty \geq \sigma \geq 4/3$ , for  $\rho \infty \geq \rho \geq 7/6$ , the relation between  $\sigma$  and  $\rho$  remaining unchanged. As Sir C. V. Raman mentioned in his letter that some new measurements of Venkateswaran had revealed that this phenomenon of "anomalous polarisation" could be best observed with thiophene, I repeated the experiment with this substance. The result was entirely negative, all Raman lines showing complete depolarisation, as was to be expected with an electric dipole radiation.

Sir C. V. Raman, to whom I communicated the result of this investigation, has answered by a letter, the relevant part of which is here published with his authorisation.

"Observations of depolarisation in excess of the  $6/7$ th permissible with incident natural light for an anisotropic electric dipole had been reported by several observers since 1928. The list includes Prof. Cabannes, Carrelli-Pringsheim-Rosen, Bhagavantam, West and Farnsworth, Parthasarathy, Venkateswaran, and others. I was impressed by this array of names, and hence was led to put forward the suggestion that a molecule may possibly scatter light also as a magnetic dipole or else as an electric quadrupole. Regarded purely as a theoretical proposition, I believe the idea to be sound. Spectroscopists have already shown that electric quadrupole radiation from atoms may be observed, and it seems not unlikely that several unexplained puzzles concerning the scattering of light may find an analogous solution.

"The remark in my note in NATURE of Nov. 7, 1931, reporting experimental confirmation of the idea by Venkateswaran was, however, premature. Subsequent experiments by Venkateswaran himself gave highly discrepant and puzzling results. The source of error appeared to be in the use of photographic

photometry, which in the case of very faint lines is liable, if sufficient care be not taken, to give misleading results. Bhagavantam has examined the matter systematically, and his conclusion is that all earlier reports of depolarisation of scattered light exceeding  $6/7$  for incident natural light are to be regarded as spurious and unjustified. No genuine exception to the  $6/7$ th rule has so far been established.

"As you are well aware, it follows from the electric dipole theory that when incident horizontally polarised light is used, all the scattered radiations must be completely depolarised. Your spectrograms with thiophene show this unmistakably to be the case, and hence must be regarded as disproving the existence of anomalous polarisation—at least in this particular case. I, however, still cherish the hope that quadrupole radiation from molecules may be detectable in specially favourable cases, and experiments with this object are being carried on here."

R. BAR

Physikalisches Institut der Universität,  
Zürich, Feb. 17

<sup>1</sup> *Ind. J. Phys.*, 5, 59, 1930

<sup>2</sup> *Helv. Phys. Act.*, 4, 130, 1931

<sup>3</sup> NATURE, 128, 795, Nov. 7, 1931

## Rapid Estimation of Water-Content in Undisturbed Soil and in Bales of Cotton

AN instantaneous method for estimating the moisture content of soil, at any particular spot below the surface of the ground, even approximately, should be very useful in plant physiology, irrigation, and in soil science generally. The high dielectric constant of water suggested to me that the variations in capacity of a 'leaky' condenser permanently buried in the soil should serve this purpose.

Alternating current from a valve oscillator is convenient to use for the purpose, but a capacity-bridge (such as is marketed by Messrs. Heilan, of Frankfurt) is impracticable, on account of power-losses to earth from the buried condenser. Resonance methods evade this earth effect (the circuit being symmetrical), and I have now worked out on this basis a technique which seems very satisfactory.

The buried condensers are conveniently made from glass web-tubing filled with mercury to give any desired capacity. Such double tubes can easily be made also in capillary form, and are then very sensitive: for example, a tube of  $1\frac{1}{2}$  mm. width externally has a capacity per centimetre of  $1.5 \mu\text{F}$  in air, which rises to a 'capacity' of  $6 \mu\text{F}$  per centimetre in water, with tubes of this size it is possible to examine localised details, such as the function of single roots.

The readings are but slightly affected by any variations of electrolytes above the level of minimum conductivity likely to be found in any soil. The 'capacity' indicated is predominately that of a zone only a millimetre or so in thickness around the tube, so that intimate contact with the soil is necessary, this is not a difficulty when the condenser is permanently buried in deep soil which never becomes air-dry. For other situations an artificial 'soil' of plaster can be cast round the tube, at the cost of making its responses sluggish.

The method can be used, with caution, for determining the concentration of mixtures of liquids which have different dielectric constants, such as alcohol and water: the web-tube is immersed in the liquid, and its gain in capacity subtracted from the variable condenser in parallel, until resonance is indicated by the grid-circuit galvanometer, which can all be done in a few seconds.

A further possible application is to 'works control'

of the moisture content of cotton bales as they issue from the power presses at Alexandria ready for export. At this moment their moisture-content is fairly homogeneous, their weight and volume are known, and the nine iron hoops securing the bale are of standardised dimensions and spacing. These hoops can thus be treated as condenser plates, which provide about 300  $\mu\text{F}$  total capacity on a bale weighing one-third of a ton and containing 8 per cent of moisture. About half of this is residual, the remainder being equally divided between the inter-hoop capacity in air, the effect of dry cellulose, and of the water therein. From this point additional moisture increases the readings rapidly (accompanied by blunting of the resonance curve due to conductivity), and the 'capacity' rises from about 300 at 8 per cent to 400 or more at 11 per cent. It should thus be possible to be sure that every bale lies between the limits of 8 per cent and 9 per cent permitted under the international agreement, and to effect this observation in about ten seconds only, which is even faster than the presses can produce the bales. The apparatus required is no bigger than an attaché-case.

In learning the technique necessary for effective use of these unconventional 'leaky' condensers, I have been helped very much by Mr. G. F. Briggs of Cambridge, by Mr. Moss of the Cambridge Instrument Co., Ltd., Mr. J. H. Cole of the Egyptian Survey, by my chemist colleagues here, Dr. W. H. Williamson and Mr. D. Grace, and by my son.

The first account and demonstration of the method was given before the Cairo Scientific Society on Feb. 28.

W. LAWRENCE BALLS

Ministry of Agriculture,  
Botanical and Plant Breeding Section,  
El Giza, Feb. 1.

#### Behaviour of Bielschowsky-stained Neurofibrillæ between Crossed Nicols

ARTIFICIAL cultivation of tissues *in vitro* has little affected the field of investigation in organic neurology. The older histological methods are still irreplaceable, and of special value is that of Bielschowsky, which renders distinguishable the minute neurofibrillæ at all stages of development save possibly the earliest at which nervous conducting structures are present. Bielschowsky's method involves the staining of the fibrillæ probably with a complex compound of silver formed through the interaction of certain of its salts in solution with the chemical constituents left in the nerve after treatment with a series of 'fixative' reagents. At least, that is a possible explanation of the visible results viewed through the microscope. The colour of the fibrillæ varies from a dark to a very dark brown or black, and unfortunately non-nervous structures are also coloured a lighter brown or yellow, so that the actual identification of the fibrillæ is in practice inferred from their visible form and connexions as well as from their appearance more or less sharply contrasted with their immediate surroundings.

Any device which increases this natural contrast would be a technical gain facilitating detection of the minuter fibrillæ affected by the Bielschowsky reaction.

It is therefore of interest that in sections stained by Bielschowsky's method the neurofibrillæ are very distinctly visible in the 45° position relatively to the crossed nicol planes. Even the smallest filaments of the marginal layer of the embryonic central nervous system are revealed with great brilliance. Figs 1 and 2 reproduce the features of untouched photomicrographs of a lumbar nerve and *ramus communicans* in a 24 mm. human embryo (Zeiss 4 mm apo-

chromatic objective, substage polariser, and eyepiece analyser, Wratter 'A' filter, and panchromatic plates. For convenience, the polariser instead of the analyser was rotated, hence the faint cross lines in Fig 1 appear in an unconventional position. The actual planes of the nicols are indicated by white lines).

A few brief comments on this result may be of interest.

(1) The neurofibrillæ are more specifically distinguished in Fig 2 than in Fig 1, that is, when viewed between crossed nicols.

(2) Maximum illumination of the images occurs in four positions at right angles and there are correspondingly four 'positions of extinction' (crossed nicols).

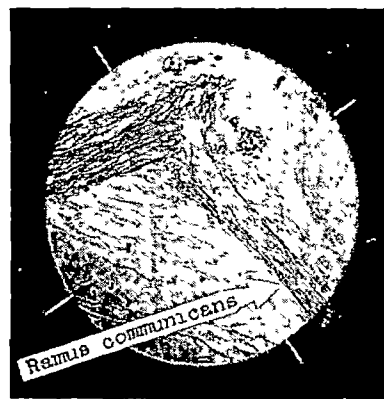


FIG 1—Lumbar nerve and *ramus communicans* of a 24 mm human embryo. Nicols uncrossed  $\times 150$



FIG 2—Same preparation as Fig 1, with nicols crossed  $\times 150$

The exhibition of this phenomenon is regarded by petrologists as a demonstration of the presence of a crystalline substance. Prof. H. H. Read tells me that the question of an alternative inference does not arise when minerals are under consideration. Nevertheless, caution is necessary in dealing with animal matter. A liquid could scarcely have survived the process of preparation, and although elsewhere I have described the production of faint images by 'casts' of celloidin hardened in contact with striped muscle, such a surface phenomenon does not appear to be involved here.

(3) The apparent absence of continuity in the lines of Fig 2 (particularly in the larger nerve) is direct evidence of the 'extinction' phenomenon, since it is due to irregularities in the course of the fibrillæ. When the object is rotated, the images appear to flow along the fibrillæ. The anisotropic substance is

therefore evenly distributed, and the optical axes of the particles have a common or parallel direction relatively to the axis of each fibril

(4) Since the images with crossed nicols are single narrow bands, uniformly illuminated, it seems that the Bielschowsky method is not an 'incrustation method'. The word 'impregnation', too, is ambiguous

(5) The reaction depends upon the specific constitution of the nerve, physical or chemical, so far as a section of animal tissue is concerned, since the optical properties are not displayed by non-nervous stained structures present, for example, the nuclei of erythrocytes, surface deposits, or mesodermal trabeculae, although this generalisation is subject to qualification (see 10 below)

(6) Living nerve is anisotropic

(7) Arising from (6), the arrangement of the anisotropic substance in Bielschowsky preparations may be due to the constitution of the nerve itself, or it may be due to the formation, in combination with the nerve, of an anisotropic substance, or it may be due to tension in the neurofibril

(8) Section of other embryonic material at a comparable stage stained with hæmatoxylin and eosin, Mallory's *saure fuchsin*, etc., and Haidenhain's hæmatoxylin do not exhibit the phenomenon. Preparations of adult mammalian tissues stained intra-vitally with methylene blue show it, but only for very short stretches of the nerve where, apparently, it is not well stained. This observation is at present confined to myelinated fibres, and the anisotropic parts appear to be localised near the nodes of Ranvier. Weigert preparations of the adult human central nervous system give a negative reaction for the nerves but a positive reaction for the adventitia of blood-vessels

(9) Striated muscle stained by Bielschowsky's method exhibits a 'sheen' when viewed between crossed nicols. I have not been able to determine whether the source of this 'sheen' is localised in the anisotropic discs as it is in unstained fibres

(10) In some preparations of a primitive vertebrate, the phenomenon is exhibited by certain elements in relation to the trabeculae of the notochord. This limitation upon (5) is itself interesting and will be the subject of further observation, for nerves have been recorded as entering the notochord<sup>1</sup>. Further, Bielschowsky material from the same subject as the Weigert material mentioned in (8) gives a strongly positive reaction for nerves and a *weakly positive* reaction for the adventitia. The peculiarities of the connective tissue in material from adults may thus limit the usefulness of these observations to young tissues, but this is uncertain

TUDOR JONES.

The University of Liverpool,

Jan 28

<sup>1</sup> Julia Platt, *Anatomischer Anzeiger*, 7, S282, 1892

### Nature of the Ionic Conductivity of Glass

It has been found experimentally,<sup>1</sup> that the equivalent conductivity of glasses of the system  $B_2O_3 + Na_2O$  increases very sharply (a million-fold) with the concentration of sodium in the glass. This increase begins at a definite concentration, about 3.5 per cent  $Na_2O$ . In order to elucidate the nature of these facts, the velocity of solution of the glasses was measured. These experiments have shown that with this system the curve of the rate of solution has a maximum and, further, a sharp fall in a certain region of concentration of  $Na_2O$  corresponding to the very beginning of the increase of equivalent conductivity (Fig. 1). Analysis of the quantitative data of the rate of solu-

tion indicates that orientation of polar molecules of borates of sodium in this region occurs.<sup>2</sup> According to Tamman's well-known data, there exist in the  $B_2O_3$  glass certain positions unoccupied by molecules (free positions).<sup>3</sup> It is easy to conclude that in the region of the increase of the equivalent conductivity, the increase of orientation of the molecules leads to their more compact packing, and this, in its turn, leads to the disappearance of free positions (positions unoccupied by molecules). In the region of small concentrations of  $Na_2O$ , the molecules of the borates of sodium are separated from each other and practically do not interact. Elementary considerations, which we here omit, make it possible to assume that the layers of the  $B_2O_3$  molecules disappear among the polar molecules of the borates of sodium just in the region where equivalent conductivity begins to increase. It is therefore natural to expect the

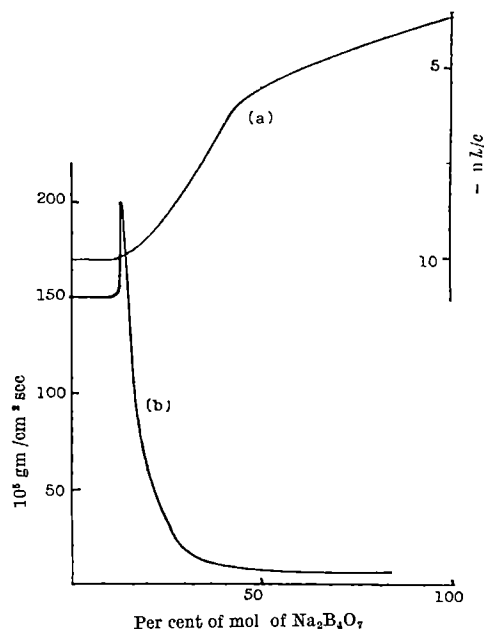


FIG. 1—*a* Equivalent conductivity at 250° C. of a borax glass, *b* velocity of solution at 100° C.

appearance in this region of a tendency to orientation among the molecules of borates, and at the same time a decrease of the energy of their dissociation ( $Na_2B_4O_{13} \rightleftharpoons Na + NaB_4O_{13}$ ) as a result of their interaction. Owing to this, we obtain a great increase of conductivity, caused, as we know, by the sodium ions

From what has been said, a subdivision follows of glasses

(a) Glasses with low sodium content. Owing to free (unused) positions, all dissociated ions have translational motion. The dissociation energy of borates does not depend on the concentration of sodium, owing to the absence of interaction between the polar molecules of borates separated from each other by the  $B_2O_3$  molecules. These conclusions agree with the experimental fact that the concentration of sodium does not influence the equivalent conductivity.<sup>1</sup>

(b) Glasses with high sodium content. Owing to the gradual disappearance of free positions, the channel-like displacement<sup>4</sup> of the ions of sodium increases, consequently, the effective velocity of the translational motion of the ions decreases. Experimentally it is manifested in the considerable decrease of

the value  $B - \ln c$  in the expression of the logarithm of equivalent conductivity

$$\ln \frac{k}{c} = -\frac{A}{T} + (B - \ln c)$$

(in which  $T$  is temperature,  $c$  sodium concentration,  $A$  and  $B$  constants) Nevertheless, the equivalent conductivity of glass greatly increases owing to the decrease of energy of dissociation of borates as a result of the interaction of their molecules Experimentally

it is shown in the fall of the coefficient  $A \approx \frac{E}{4}^{1,5}$

It is found that the dissociation energy  $E$  falls with the increase of molecular concentration of the polar molecules of borates  $m$  (per  $\text{cm}^3$  of glass) according to the equation

$$E = \frac{3.6}{\sqrt{m}} \text{ cal}$$

The transition from the vitreous to the crystalline state is followed by the disappearance of the free positions<sup>3</sup> The fall of conductivity to be expected in this case is shown experimentally to take place in the system  $\text{Na}_2\text{O} + \text{SiO}_2$ <sup>6</sup>

It seems that the maximum of the rate of solution corresponds to the intermediate region of concentration in which the  $\text{B}_2\text{O}_3$  monomolecular layers disappear, the molecules of borates, which were formerly separated from each other, are now drawn together and begin to interact, the van der Waals' cohesion forces between the  $\text{B}_2\text{O}_3$  molecules in glass are replaced by forces acting among the polar molecules of sodium borates

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<sup>1</sup> S Schtschukarew u R Muller, *Z phys Chem*, 150 A, 439, 1930

<sup>2</sup> G Tamman, *Z anorg Chem*, 90, 297, 1915

<sup>3</sup> G Tamman u E Jenkel, *Z anorg Chem*, 184, 716, 1929 186,

171, 1930

<sup>4</sup> G v Hevesy, *Z Physik*, 2, 178, 1920

<sup>5</sup> J Frenkel, *Z Physik*, 35, 652, 1924

<sup>6</sup> R Schwarz u J Halberstadt, *Z anorg Chem*, 199, 33, 1931

#### Application of the Electrometer Triode to the Measurement of High Resistance

In some experiments made by us on the application of the electrometer triode to the measurement of the ionisation produced by radioactive substance and X-rays, alcohol xylol resistances of the order  $10^3$ - $10^6$  megohms have been employed A method of measuring such resistances has been devised, in which use is made of the very high grid-filament resistance of the triode The arrangement is indicated in Fig 1  $R_1$  is a known resistance,  $R_2$  is the resistance to be determined With the potentiometer short-circuited and the key  $K$  open, the normal anode current is first balanced by variation of the resistance  $Z$  in the short-circuit  $GZ$ , so that the galvanometer indicates zero The key  $K$  is now closed, and the current in the circuit  $ER_1R_2$  alters the voltage of the grid by an amount equal to the voltage drop across  $R_1$  The anode current is thereby altered, and the galvanometer is deflected The grid is now restored to its original potential, by applying to it a potential by means of the potentiometer  $P$ , the reading of the potentiometer  $e$  being a measure of the voltage across  $R_1$  Obviously then

$$R_2 = R_1(E - e)/e$$

Resistances up to  $10^6$  megohms have been measured in this manner, the procedure being to construct a series of alcohol-xylol resistances of the order  $10^2$ ,  $10^3$ ,  $10^4$ , and  $10^5$  megohms The lowest of these is first compared with a standard resistance of 10

megohms This is then used as a standard to measure the  $10^3$  megohms, the process being repeated for the higher resistance

$E$  is usually a two-volt battery, and for accuracy the ratio of  $R_2/R_1$  should not be much less than 10<sup>1</sup> The valve employed in these measurements is supplied by Philips Lamps, Ltd, and its chief characteristic, which makes it so suitable for such measurements, is that the grid current, when the grid bias is

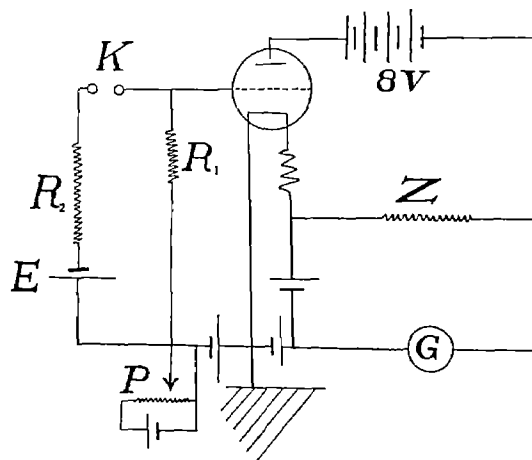


FIG 1

- 2 volts, is less than  $10^{-14}$  amp The method cannot be employed for resistances above  $10^7$  megohm, as resistances of a higher order are comparable with the grid filament resistance of the valve

The potentiometer employed is by the Cambridge Instrument Co, Ltd, and a comparatively insensitive galvanometer (1 division per microamp) is sufficient

Further details of the method will be published later, in connexion with the work on ionisation measurements which are in progress

J A C TEEGAN  
NANCY HAYES

University College,  
Cork, Feb 4

#### The Revival of Scholasticism

I It is difficult to see just what is the meaning attached to 'direct contact' in the statement that "we have no means of getting into direct contact with them [physical objects]" ("The Decline of Determinism", NATURE, Feb 13, p 235) For, the fact that the sense-organs merely reflect objects is not a modern discovery it was the basis of Francis Bacon's inductive philosophy "Our method is continually to dwell among things soberly, without abstracting or setting the understanding farther from them than makes their images meet" "For however men may amuse themselves, and admire or almost adore the mind, it is certain that, like an irregular glass, it alters the rays of things" "The capital precept for the whole conduct is this, that the eye of the mind be never taken off from things themselves, but receive their images truly as they are." "The mind is like a glass, capable of the image of the universe as the eye to receive the light" (Preliminaries, "De Augmentis Scientiarum")

In the "Anugitā Upanishad", one of the earliest known philosophical writings, it is repeatedly stated that the senses are conscious only of the qualities of 'objects', which are themselves merely appearances—*Māyā*, in effect, merely condensations or accumula-

tions of energy. Any 'contact' with these accumulations can be, of course, but our consciousness of an electromagnetic 'contact' or interaction. This 'sensation' of an 'image', a 'sound', etc., is immediate. Inferences are subsequent and are formed by another aspect of consciousness—the *rational mind*, an extreme development of the function which operates in the higher animals *immediately as instinctive inferences*. 'Time' is, therefore, a synonym for deliberation and ratiocination about appearances. It deludes speculative thinkers, who, as Bacon pointed out, confuse metaphysics with physics, 'final causes' with 'physical motions'. They expect to find the principle of cause in the chimeras of the mind.

II The *inferences* with which the external world is said to be populated (p. 236) are the progeny of human reasoning, which erroneously presumes that 'time' is predicative and causal: they are not born of judgment by induction, whereby "we both find and judge by the same operation of the mind, almost in the same manner as by the sense", that is, when the understanding reflects the inner 'forms' of things. Bacon should be re-read in the light of our modern knowledge of electromagnetic induction. 'Cause' is in the nature of things, not in 'time' or in ratiocination. Things are so, and could not be otherwise, given a certain *combination* of 'relations' and 'motions'. That which is given is isolation or tension, which is independent of 'time'. Experimental science has been built up on a progressive knowledge of the principle of isolation, and this has been obtained by the inductive use of the mind, in Bacon's sense. "A true and legitimate union between the experimental and rational faculty, the undue separation thereof has caused the greatest disturbances in the family of mankind"—theological disputes and religious persecutions.

III It is surely not correct to state (p. 233) that 'determinism' has been the attitude of science for more than two hundred years. The word itself shows its scholastic origin. Its crude connotation was foisted on science in the nineteenth century—not by *experimental workers*. Father Félix, the famous preacher at Notre Dame de Paris in the 'fifties, foresaw the inevitable reaction from 'determinism' and 'predicted' that mystery would be the fatality of science. To-day the clerical party in the popular press are boasting that "science has lost its old arrogance", that its labours have been in vain, and that man must resign himself to uncertainty with regard to knowledge. 'Determinism' and 'indeterminism' are alike speculative inferences of Neo-scholasticism, which is flourishing to-day in England and on the Continent because inductive philosophy has provided it with a vast amount of data on which to speculate. There is a point in the cycle of every civilisation when sophistical thinking balks the work of experimental science, and the civilisation thereafter declines.

IV The labours of the great experimenters demonstrate that, as a creative thinker, man is superior to physical Nature. He can insulate his mind, shut out the rays reflected by the appearance of things, stop the activity of the 'natural reason' temporarily, and so induce an energy in the brain, of an order different from the energies of physical propagation and reproduction, which effects transformations, whether indirectly in the laboratory or directly in the physiological 'habits' of his own organism (p. 240), and alters tendencies to normal or natural reactions. Man creates civilisations and their arts, reshapes his environments, and can remould his thoughts, if he will. Has a brain of this generative power been found elsewhere in Nature? Hence, it seems "incredible what a number of idols have been introduced into

philosophy by the reduction of natural operations to a correspondence with human actions, that is, by imagining Nature acts as man does, which is not much better than the heresy of the anthropomorphites that sprung up in the cells and solitudes of ignorant monks" ("De Aug. Scient.", XIV.)

W W L

### Determinism

IN discussions which have taken place recently in the columns of NATURE, and elsewhere, on the subject of determinism, various aspects of the problem are omitted which appear to me to be important. In the first place, both determinism and indeterminism are subjective phenomena, dependent on mind, and subject to its limitations, including fallibility. Secondly, they are eternally associated in mind, and become meaningless in isolation. A universe ruled entirely by determinism is to me as unthinkable as one subject to pure chance. The difficulty is with our human minds to attempt to adjust ourselves to a world which appears to be partly determined and partly fortuitous.

In the inorganic, and microscopic, world, scientific research steadily eliminates the element of chance, as experimental error diminishes. Astronomical phenomena can now be calculated with very fine precision, and earthquakes are no longer considered to be entirely capricious. It matters little whether uncertainty still reigns in atomic physics, since even the realisation of this has been arrived at by methods which, in being scientific, rest on an implicit faith in causality. All we can say is that at present we do not *know* exactly how an electron behaves. By analogy we may at least expect that the path of an electron is as rigidly determined as that of the earth, or the moon, we merely know less about it. Similarly, although the shaking of a box of dice may be a purely physical process, the results will appear to us to be governed by chance, simply because we cannot calculate and measure all the forces involved. Here chance emerges on one side as a measure of the limitations of human mind, and on the other, of the complexity of the universe.

In the organic world the problem becomes greater, while remaining essentially the same. A living thing has a biological urge which we recognise as purpose, and which determines how it will behave. This presupposes a universe sufficiently reliable to admit of adaptations, for adaptation in itself implies necessity, but since it can never be perfect, a margin is left over for chance, and for evolution, while within one generation chance determines food supply, survival, reproduction, and dispersal. In absolutely identical situations we may well expect identical twins to react in exactly the same way, but identical twins are comparatively rare, and identical situations, in our knowledge, are rarer still. There is therefore scope for free will, in so far as on one side the universe is apparently governed by necessity, and on the other is capricious enough for individual decisions to be made.

In naive experience we human beings are conscious of both determinism and chance. To us the slavery of the ant appears repulsive, and while we try to eliminate the element of chance from economic life, the logical outcome of our efforts would terrify us. Some equilibrium between determinism and chance appears to be an essential condition for a healthy life. Such an equilibrium lies at the root of many human activities, as in conventions, fashions, morals, adventure, and romance. It supplies a basis for the assessment of character. It runs as a thread through all art, which on one side is limited by reality and style, and on the other admits of individual imaginative

treatment It appears in betting, and it is the basis of all games The degree of capriciousness which can be tolerated varies for each individual, but it never vanishes

R WEATHERALL

Eton College, Windsor,  
March 7

### Physiological Specialisation of *Hemileia vastatrix* B and Br

In the course of some recent work on the behaviour of a number of hybrids and selections of *Coffea arabica* Linn, collected at the Mysore Government Coffee Experiment Station, towards infection by *Hemileia vastatrix* B and Br, indications of the existence of physiological specialisation in this rust fungus have been obtained

It had previously been found possible to carry out inoculation experiments on detached leaves in the laboratory, and to keep such leaves healthy for at least six weeks The method was applied to testing a number of resistant and partly resistant selections Among these, one selection, *S* 5/30, was found to be completely resistant to spore collections made from the Coorg variety of *Coffea arabica*, though it showed

Identical results have been obtained in a number of similar experiments There are indications of very minute chlorotic flecks in the case of Coorg spore infections on *S* 5/30 leaves, and the histology of these flecks is shortly to be investigated The infections caused by the two spore collections on the Coorg leaves and the *S* 5/30 spore collection on the *S* 5/30 leaves are morphologically indistinguishable

Up to date, only one plant exhibiting this difference in behaviour to different spore collections has been found Work is in progress involving the study of plants of the same origin as *S* 5/30 and other plants showing variations in behaviour to *Hemileia vastatrix* A full account will be published when results are available

I am indebted to Mr M J Narasimhan, mycologist, Department of Agriculture, Mysore State, for the photographs of infected leaves

W WILSON MAYNE

Mysore Government  
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Balehonnur, Kadur District,  
Mysore State,  
Jan 20



FIG 1

itself to be somewhat susceptible to the rust in the field

Tests were then made with collections of spores from the Coorg variety and from the selection itself Four leaves from a susceptible Coorg tree and four from the selection *S* 5/30 were inoculated on the right-hand side of the midrib with a Coorg spore collection and on the left-hand side with an *S* 5/30 spore collection Six areas on each half-leaf were infected by dusting the spores on the surface of drops of sterile distilled water The results were as follows

#### Coorg Leaves (Fig 1, A)

Right-hand side Coorg spore collection, 21/24  
successful inoculations  
Left-hand side *S* 5/30 spore collection, 17/24  
successful inoculations

#### *S* 5/30 Leaves (Fig 1, B)

Right-hand side Coorg spore collection, 0/24  
successful inoculations  
Left-hand side *S* 5/30 spore collection, 23/24  
successful inoculations

No 3257, Vol 129]

### Microscopic Measurements

In elementary biological classes the measurement of microscopic objects is useful for training in accurate observation and for the intelligent use of the various parts of the microscope In this connexion it may be pointed out that the estimation of the vertical distance between objects in microscopic preparations helps greatly in the realisation of solid forms and of the information which may be obtained from superimposed optical sections The estimation can be made very simply by the use of a microslip carrying on one side a short line of transparent red, and on the other a similar line of green, glass ink The lines cross each other and form an 'X' when one looks vertically through the slip. From the thickness of the slide at X, ascertained with a coverglass-micrometer, and the number of revolutions of the milled head of the fine adjustment of the microscope, which are required to pass from the level of the focus of the red to that of the green line, the pitch of the screw and the value of the movements of the fine adjustment are obtained

Despite errors due to accommodation and refraction the use of the fine adjustment calibrated in this way is very advantageous, and, when combined with micrometric observations in a horizontal plane, conveys a sense of solidity which can scarcely be obtained so simply by any other method By way of example, the vertical diameter of a filament of *Spirogyra portucalis* was estimated by this method as 0.021 mm, while its horizontal diameter, found by the 'ghost micrometer', was 0.0198 mm

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### Catalysis in an Inert Solvent

As Dr Traill is now in Australia, I may direct attention to the fact that calculations of a similar character to those given by Dr Moelwyn-Hughes in NATURE of Feb 27, p 316, had already been made by him These were published in the February number of the *Philosophical Magazine* under the title "Kinetics of a Catalysed Isomeric Change in Solution", whilst Dr Moelwyn-Hughes's letter was in the press

T M LOWRY

Laboratory of Physical Chemistry,  
Cambridge, Feb 27



## Research Items

**Troy**—Archæological and geographical problems relating to the site of Troy and its identification with Hissarlık are discussed by Miss Winifred Lamb in *Antiquity* for March in the light of her excavations at Thermi in the Island of Lesbos. Doubts, which had long been dormant, have been raised recently by the contention that there was no room for the Achæan camp and the actions described in the *Iliad* on the land between Hissarlık and the Hellespont. A number of treatises have maintained in consequence that Hissarlık is not Troy, and that Troy was not situated on the Hellespont. An alternative site at Besika on the west coast has been suggested, but is untenable, while the view that Hissarlık was a burial ground of the Achæans is not in accordance with archæological fact. If another Troy is to be found, it must be by excavation of some of the still unexplored mounds of the Troad. At present the position of Hissarlık can be tested only by comparison with other settlements of the same culture. The excavations at Thermi for the first time have afforded architectural material which can be placed side by side with that of Troy. Five towns, one above another, have been uncovered, giving the whole plan of the upper town with about three-quarters of each of the others. The period after Troy I when Hissarlık was deserted was for Thermi III a period of growth and activity, and Thermi also reflects the prosperity in Anatolia which was heralded by the foundation of Troy II on an unprecedented scale. Before the fall of Troy II, destroyed possibly by the Hittite, the Thermiotes seem to have anticipated danger, for they abandoned the site.

**Thorn-lined Traps**—An interesting question of distribution is raised by Mr Henry Balfour in *Man* for February in describing certain thorn-lined traps now in the Pitt-Rivers Museum, Oxford. A note on specimens of these traps which appeared in *Man* in 1925 has elicited information of examples from different areas and in use by various peoples, showing practically a continuous dispersal range from the area north of the Brahmaputra to Melanesia. The traps are clearly closely related to one another and have a common origin. An example is now known from a new and unexpected locality. It was collected by Dr E. Evans-Pritchard among the Azande of the Welle District in eastern Sudan. This trap is a long narrow tube of open basket-work, consisting of eight strips of split cane fastened together at one end and running in a nearly parallel, but slightly diverging, series to the full length of the trap. The strips are woven to form a rigid, slightly tapering basket in which three thorn-bearing twigs are fastened, so that a small animal, such as a rat, is afforded easy ingress, but cannot back out. It resembles very closely a type found among the Konyak Nagas, which is also used for catching rats. The occurrence of this type of trap after so wide a gap in distribution raises an interesting question as to whether it is to be referred to a common prototype or is to be regarded as a case of independent origin. A tubular form of trap, but differing in action, is widely dispersed in tropical Africa.

**Growth of Wool in Australian Merino Sheep**—By the periodic measurement of the mean length of adjacent locks or staples at fixed points on the shoulders of the merino sheep, K. M. Fraser has investigated the growth of the fleece of merinos grazed on 'natural' pastures throughout the year (*J. Coun. Sci. Indust.*

*Res.*, Australia, 4, 204, 1931). It is to be noted that the elongation of the staple does not necessarily correspond to the average rate of growth of all the fibres in the staple, but it is on staple form that breeder, buyer, and wool expert base their judgments. Fraser found that the body-weight of the sheep themselves showed very considerable fluctuations, associated with the alternation of periods of drought and heavy rainfall during the year and consequent shortage and luxuriance of pasture. But in spite of this, the rate of growth of the staples showed uniform progress throughout the year, the actual increase from the first measurement of 30.26 mm in November to the corresponding time in the following year being 114.20 mm (3.3 in). It is probable that the principal effect of the seasonal drop in weight of Australian sheep in autumn, when the nutritional value of the natural pastures falls away, is reflected in the thickness of the wool fibre instead of in the staple length.

**Habit and Physiology of *Calanus***—The Annual Report (1930-31) of the Scottish Marine Biological Association shows that research is flourishing at the Millport Marine Station. Mr A. P. Orr and Miss S. M. Marshall have devoted themselves mainly to the study of *Calanus finmarchicus*. Samples of about a hundred individuals were taken from the tow-nettings at least once a month throughout the year, the proportions of males, females, and young stages determined and a certain amount measured. The main breeding period is early spring but reproduction goes on sporadically throughout the summer. The largest specimens are to be found in April. During autumn and winter, when *Calanus* was very scarce elsewhere, there were always large numbers to be found in the deep waters of Loch Fyne, mainly immature. Experiments have been made on the rate of metabolism, as measured by the oxygen consumption, of males, females, and stage v (the stage immediately preceding maturity) under different temperatures, oxygen content, and hydrogen ion concentration. It is found that lower oxygen concentration can be tolerated at lower temperatures. The lowest values they can tolerate are met with only occasionally in the sea, and *Calanus* is apparently insensitive to the changes in the hydrogen ion concentration which are likely to be met with under natural conditions in the sea. Males and females behave similarly so far as they have been compared, but immature *Calanus*, in spite of their greater activity, have a lower oxygen consumption. Research on the digestive enzymes of *Calanus* gives much promise for future work. Enzymes have been obtained which will split cane sugar, starch, and glycogen to give reducing sugars, and others which liquefy gelatine and attack fibrin to a slight extent.

**A Fungus Disease of Lavender**—Price-competition and the 'shab' disease have combined to send lavender out of cultivation in England. It only remains for growers to make a fresh start, in view of the recent imposition of duty on foreign perfumes and the fact that the 'shab' disease is now known to be caused by a fungus—*Phoma Lavandulæ* ("The 'Shab' Disease of Lavender", by C. R. Metcalfe, *Trans. Brit. Mycol. Soc.*, vol. 16, parts 2 and 3, pp. 149-176, Dec. 1931). Mr Metcalfe has shown this conclusively by inoculation experiments, but has also demonstrated that certain climatic and edaphic factors may produce similar symptoms. Methods of control based on plant hygiene have proved successful in

several instances. The main trouble, however, lies in the fact that a plant may be infected for a considerable time before it shows symptoms. This has resulted in the spread of the disease under the older conditions of propagation, such as the splitting of whole plants to form cuttings. A method of taking small cuttings from soft, green woody shoots has given good results in controlling the disease. *Lavandula dentata* and the dwarf French variety of *L. vera* are reported to be immune from the disease, though non-fragrant, and offer good possibilities for the production of perfume-bearing immune varieties.

**Bermuda during the Ice Age.**—Mr Sayles has now summarised his study of the Bermuda Islands during the last eight years ("Bermuda during the Ice Age", *Am Acad Arts Sci*, vol 66, No 11). The Bermuda volcanoes, erupted during the Tertiary or earlier, were reduced by the end of the Tertiary to submarine platforms. With the coming of the Pleistocene glaciation, water was subtracted from the oceans to cause a fall of the strand line to as much as 260 ft below present sea-level. While the ice-cap grew large, parts of the Bermuda banks, covered by marine deposits and unprotected by vegetation, were exposed to the sweep of the winds, and the dried sands were piled up into great dunes. These dunes were preserved owing to the very quick cementation that takes place when this eolian shell sand is exposed to the atmosphere. Their formation was favoured by the inevitably harder and more stormy conditions of the ice age in this latitude. The sea rose at the close of each glacial stage, the bases of the dunes were buried beneath the waves, the winds became less violent, and a permanent flora anchored the dunes. Soil accumulated, but with the advent of new glacial stages conditions became again favourable to the formation of dunes, which covered up the earlier soil layers. The geology and palæontology of these interglacial soils are carefully studied, and enable the author to suggest in detail the history of the formation of these islands in the Pleistocene. Lastly, a twelve-foot drop in sea-level is recorded by an emerged bench, cut probably only a few thousand years ago. Bermuda has long been known not to be an atoll, its corals being only the thinnest of veneers. Its basin, about sixty feet deep, perhaps owes its existence to the protection of the central parts of the former land by the dunes which lie round it to the south and east. We judge that the Challenger and Plantagenet Banks to the south of Bermuda, covered by about thirty fathoms, were probably too small for the permanent formation of dunes.

**Passage of Ionising Particles Through Matter.**—The question of the relation between the energy of a charged particle and the rate at which it can produce ions in a gas has become one of the main and most unsatisfactory problems connected with ionisation. Following upon earlier theories of the effect, due to Bohr and others, a new attempt at the analysis of what occurs was made two years ago by Bethe, on the basis of the wave mechanics. The *Proceedings of the Royal Society* for February contains two papers, by E J Williams and by P M S Blackett, the main theme of which is the comparison of Bethe's theory with experiment. The general conclusion seems to be that Bethe's theory is an advance on earlier work, but that it is still not a completely adequate account of what occurs. Various ways of reconciling the divergence between theory and experiment are considered, but special interest is perhaps attached to the point made in Williams's paper that there is ambiguity in what have generally been considered straightforward ionisation experiments. This arises

in two ways, from an electrode effect, and from an effect of impurity in the gas. The former is that, as has now been established in many experiments, there is an emission of electrons in most circumstances when positive ions are neutralised at a metal surface, this would increase the ionisation current recorded over that due to the primary production of ions in the gas. The latter is that excited atoms may ionise impurities in the gas, and again produce an additional source of current to the collecting electrodes. It is not clear if these will account completely for the discrepancy between theory and experiment, and there is in fact some indication that this will not be the case, but it has been shown that there is need for reconsideration and improvement of technique in this type of work.

**Testing Broadcast Receivers.**—The testing of broadcast receivers is much more difficult than testing other electrical appliances. It is possible to get definite results under definite conditions, but to use these results to compare the relative merits of receivers under widely different conditions is practically impossible. The paper, therefore, read on March 2 to the Institution of Electrical Engineers by H A Thomas on the methods of testing radio receivers at the National Physical Laboratory should prove useful to both manufacturers and users of broadcast apparatus. A suggested specification of the requisite tests is given, together with the experimental results obtained. This specification is examined as to how far it is applicable to the relative comparison of widely varying types of receiver, the number of necessary tests being reduced to a minimum, and a new method of expressing the results of the tests by a 'figure of merit' is explained. It is possible with modern receivers to obtain a very large range of sensitivity, but this test by itself is not of great importance. The author suggests that a definite value of the sensitivity be fixed and the other properties of the receiver determined at this rated value. Most receivers are required to operate under known local conditions. The field strength is known when the receiver operates in a known broadcast service area. So also, the amount of interference from other radio stations, the hum from the supply mains, the noise from tramways, etc., are approximately known. The receiver should therefore be tested as nearly as possible under the known conditions of working. The field is divided into three service areas, A, B, and C, the field strength of A exceeding 10 millivolts per metre and that of C 2.5 millivolts per metre. As the output of receivers differs so widely, they are divided into five classes according to their output. A 'B3' receiver, for example, is one which gives a medium output—that is, one lying between 500 and 1000 milliwatts when a field strength of 5 millivolts per metre is applied to the standard aerial.

**Induced Molecular Asymmetry.**—Prof Richard Kuhn, of Heidelberg, has observed (*Ber deutsch chem Gesell* Jan 1932) some optical effects in solution which he suggests may help to throw some light upon the biological formation of optically active compounds from inactive substances. Thus the salts which *p p'*-dimetrodiphenic acid forms with quinine and cinchonine are very strongly dextrorotatory, the value for the specific rotation for sodium light of the quinine salt being about +700°, whereas the salts which these bases form with *m*-nitrobenzoic and phthalic acids exhibit merely normal levorotatory values. The strong dextrorotations are attributed to the development of an asymmetric configuration of the diphenyl nucleus similar to that described by Christie

and Kenner In the present case, however, the asymmetry and consequently the activity disappear as soon as the optically active base is eliminated, since there is no sterically hindering substituent present in the ortho position to interfere with the free rotation of the two aromatic nuclei about their common linkage The author suggests the term 'asymmetric rearrangement (*Umlagerung*) of the first kind' to distinguish it from that 'of the second kind', which is permanent and is the usual type involved in the usual resolution of racemic compounds If the explanation is correct, this would appear to be a remarkable case of 'induced asymmetry', first described by Lowry and E E Walker (*NATURE*, April 19, 1924, p. 565) in connexion with semi-polar double bonds.

**Magnetism of Bivalent Copper and Silver Compounds**—For atoms of the first transition period (scandium to copper) the magnetic moment in Bohr magnetons is  $\mu_a = \sqrt{4s(s+1)}$  or  $\mu_B = \sqrt{4s(s+1)} + l(l+1)$ , where  $s$  is the total spin moment of the electrons in the sub-group and  $l$  the orbital magnetic moment Most simple salts of elements in this period give values corresponding with  $\mu_a$  Univalent copper and silver have a complete sub-group of 10 electrons, in a  $3s$  level for copper and a  $4s$  level for silver They are therefore diamagnetic Bivalent copper and silver

ions have nine electrons in this sub-group and should be paramagnetic With  $s = \frac{1}{2}$  and  $l = 0, 1$ , or  $2$ , the values of the moments are  $\mu_a = 1.73$  and  $\mu_B = 1.73, 2.24$ , or  $3.00$  It has already been shown (*NATURE*, 128, p. 31, 1931) that the bivalent silver in *tris-aa'*-dipyridyl argentic chlorate is paramagnetic, and Sugden (*J Chem Soc*, Jan) has now examined a number of other co-ordination compounds of bivalent silver and also cuprous and cupric compounds Bivalent silver is known only in the form of co-ordination compounds of its salts with substances such as pyridine and dipyridyl He finds that both copper and silver in the univalent condition have zero magnetic moment, whilst the bivalent atoms of both elements exhibit moments of 1.72-2.16 Bohr units, in fair agreement with the value predicted for one unbalanced electron In the same issue of the *Journal* this author also describes the measurement of the moment of a paramagnetic organic compound which contains an odd electron, prepared by Kenyon and Banfield in 1926 This gave a moment of 1.68, close to the value 1.73 for one unpaired electron Excluding substances which contain transition elements with incomplete inner groups, chlorine dioxide, nitric oxide, and nitrogen peroxide have previously been examined The first two give approximately the values expected for one unpaired electron, but the nitrogen dioxide is somewhat anomalous

### Astronomical Topics

**Astronomical Notes for April**—Venus is resplendent in the evening sky It is at its greatest elongation,  $46^\circ$  east of the sun, on April 19, being then half-illuminated The illuminated portion of the disc diminishes during April from 0.60 to 0.44, the stellar magnitude rises from  $-3.8$  to  $-4.1$  Jupiter is still observable for more than half the night, but its diameter is diminishing On the evening of April 19 only two satellites are visible after 7.25 p.m., III being eclipsed and II occulted

A star of mag. 6.4 is occulted by the moon on April 9 at 10<sup>h</sup> 14<sup>m</sup> p.m. The moon is barely 4 days old, and the earthshine should be conspicuous, this makes it easier to note the approach of the moon's limb to the star

Two periodic comets, Grigg-Skjellerup and Neujmin (2), should be telescopically observable, ephemerides are given in the British Astronomical Association's Handbook for 1932

Only two minima of Algol occur at convenient hours, on April 2 at 8<sup>h</sup> 12<sup>m</sup> p.m., and on April 22 at 9<sup>h</sup> 54<sup>m</sup> p.m.

Summer Time begins on April 17, 1<sup>h</sup> must be added to the times given above, to express them in Summer Time Note, however, that Summer Time should not be used in astronomical records

**An Ancient Conjunction of the Moon and Venus**—Dr P. V. Neugebauer has published a note (*Astr. Nach.*, 5847) on a cuneiform record which describes an observation made at Babylon on the morning of the 25th of Sivan in the 5th year of Darius Ochus ( $-418$  June 19) He uses it to test various values of the mean motion and secular acceleration of the bodies concerned The record uses the word 'night' and states that Venus coincided with the moon's southern horn It may therefore be assumed that the conjunction occurred some time before sunrise, which fixes the time within rather narrow limits The author concludes that Dr Cowell's large value of  $4''$  per century for the sun's acceleration is ruled out The use of Brown's Tables for the moon, and those of Newcomb for the sun and Venus, brings the

time of conjunction into daylight Schoch's values for the secular accelerations give a satisfactory representation of the observation, but it is also possible to satisfy it with values considerably different The observation is, however, sufficiently definite to receive some weight in a discussion of ancient records

**Interesting Object with Rapid Motion**—M. Delporte, assistant at the Royal Observatory of Belgium, Uccle, discovered an object of the ninth magnitude on March 12 that was almost in opposition to the sun and yet was advancing more than  $1\frac{1}{2}^\circ$  daily, and moving north at about the same rate Its aspect was stellar, but its motion indicates cometary nature Though approaching both sun and earth, it faded quickly, Dr Steavenson finding the magnitude 13.2 early on March 18

An I.A.U. telegram gives the following parabolic orbit computed by Dr Bengt Stromgren

|          |                        |
|----------|------------------------|
| $T$      | 1932, April 10 897 U T |
| $\omega$ | $34^\circ 7'$          |
| $\Omega$ | 171 38                 |
| $i$      | 19 30                  |
| $q$      | 1 1208                 |

|                              | R.A.                                                    | N. Decl.       |
|------------------------------|---------------------------------------------------------|----------------|
| Ephemeris for 0 <sup>h</sup> | March 26 13 <sup>h</sup> 55 <sup>m</sup> 0 <sup>s</sup> | $25^\circ 45'$ |
|                              | March 30 14 38 56                                       | 31 42          |

Almost identical elements were deduced by the Rev. M. Davidson Dr A. C. D. Crommelin notes that the orbit is very similar to that of the comet Tuttle-Giacobini, 1858 III and 1907 III If it is identical with that comet,  $T$  is about April 11, period about 6.2 years,  $q$  about 1.11, the remaining elements being nearly the same as Dr Stromgren's The identity of the above two comets was not immediately recognised It was first suggested by Prof. W. H. Pickering, and is highly probable, whether the present object is the same body or not If it is the same, it has lost most of its gaseous envelopes since 1907, but there must have been some kind of outburst about March 12 to explain its temporary brightness then

## Quantitative Methods in Vitamin Assays

THE variability in the responses of a group of animals to the administration of the same substance usually necessitates taking, as criterion of response, the average for the group. In many instances, even with the use of a large number of animals, the average response shows significant variations when the administration of the same dose is repeated on different occasions. If the assay is to have any quantitative value, it is essential to use a standard of reference, with which the substance under test can be directly compared. Thus the individual variations within the group are controlled by the use of a sufficient number of animals, such that each time the group selected is truly representative of the population available for test, whilst the variations in sensitiveness from day to day are controlled by the use of the standard of reference.

These principles have been applied, in certain recent investigations, to the improvement of the animal tests for some of the vitamins. A further complicating factor here is the difficulty, frequently encountered, of estimating the degree of response in other tests, death or convulsions, for example, are definite end points, and it is often possible to measure accurately the amount of a drug which will just arrest the heart. In vitamin assays, the growth rate is often a valuable criterion, susceptible to a fairly wide range of quantitative expression, but it suffers from the disadvantage of being affected by a variety of factors other than the one under test. In other cases, it may not be possible to give any numerical expression, other than a purely arbitrary one, to the degree of response: thus, in vitamin D assays, it is usually possible to say whether a degree of calcification induced by its administration is greater or less than that observed in the bones of other animals, but not how much greater or how much less.

A recent report from the National Institute for Medical Research describes a method for overcoming these difficulties in vitamin D tests and for obtaining results accurate to within a few per cent.<sup>1</sup> The general management of the animals was that usual in such tests: young rats were fed on a restricted diet until 45–50 gm in weight and 3–4 weeks old, and then given Steenbock and Black's rachitogenic diet for four weeks. At the end of the first two weeks, the animals were anaesthetised with ethyl chloride and their right knee joints radiographed; for the second two weeks they were given daily doses of vitamin D in oil by pipette. They were then killed and the right knee joints again radiographed. The first radiographic examination enabled the observers to reject animals showing imperfect rickets, since it was found that the degree of healing obtained in the subsequent two weeks did not give the same picture as that shown by animals with severe rickets, and also that the variations between litter mates were greater when the rickets was milder. Too severe a degree of rickets also increased the variability of the response to the vitamin. The doses of the latter were always in the ratio of 2:1, in each litter, equal numbers of animals were placed on the standard solution and on the solution under test. The odd animal in uneven litters was kept as a negative control. The standard solution used was about thirty per cent stronger than that now issued by the Institute for general use.

For their assays, the authors constructed a scale of healing: photographs were selected showing just perceptible differences from each other and arranged

in order from no healing up to complete healing. Twelve such steps were distinguishable, although the dose of vitamin D which caused complete healing was sixty-four times that which just failed to produce any visible calcification. When the differences in scale reading for doses of vitamin in the ratio 2:1 were averaged for large numbers of pairs of rats from the same litter, it was found that the mean scale difference was constant at about 1.9 divisions. Hence, although the dose given is increased twice at each step from the bottom of the scale, the degree of healing only increases two divisions at a time, in other words, the scale is approximately logarithmic in nature, the change in scale number produced by a given change in dose being directly proportional to the change in the logarithm of the dose. It is probable that this indicates that the rate of healing is proportional to the logarithm of the dose, at any rate over a limited range.

It was not found possible to use the scale without a standard preparation, owing to the great variations in sensitiveness of the animals at different seasons of the year, as well as between litters at the same season. They appeared to be most sensitive in summer and least so in autumn and winter. For the same dose of vitamin, the healing figure might vary six divisions on the scale at different times. The relationship between difference in dose and difference in scale reading was checked by selecting all rats which had shown a given degree of healing and then finding the scale numbers of all litter mates which had received half or twice this dose. The two sets of figures thus obtained were then averaged and indicated that, for the middle ranges of the scale, doubling or halving the dose produced a change of two scale divisions. Possible errors in this calibration were taken into consideration. The change of two scale divisions for doubling or halving the dose appears to be constant over long periods of time, but since it is possible that variations occur, it is advisable in routine testing to choose doses of unknown solution both above and below those of the standard.

In several recent investigations, attempts have been made to construct curves relating dose and effect in the case of other vitamins. The scale used by K. M. Key and G. K. Elphick for the assay of vitamin C bears the closest resemblance in type to that used by Bourdillon and his co-workers.<sup>2</sup> When guinea-pigs are given a scorbutic diet, changes occur in the structure of the teeth. Hoyer was able to recognise ten stages in the development of scurvy based upon these alterations. Key and Elphick, in re-examining these observations with the view of finding a basis for a quantitative method of assay, were only able to define five stages between scurvy and complete protection. Groups of young guinea-pigs were given a diet of bran, crushed oats, and dry skim milk with cod liver oil twice weekly. The experimental animals received also 0.75, 1.5, or 3.0 c.c. orange juice daily. The test was continued for fourteen days and the animals then killed. In this period, there were no differences in rate of growth amongst the experimental animals and the negative controls. The degree of scurvy developed in this time was only slight, although more definite in the latter. It was estimated by examination of transverse sections of the roots of the incisor teeth, the disease being characterised by disorganisation of the odontoblasts, the presence of an inner dentine, calcification of the predentine, and absence of Tomes' canals.

When the degree of scurvy was given a scale number

from 0 to 4, it was found that the average degrees of protection for groups of fifteen animals were 0.6 for the negative controls and 1.4, 2.4, and 3.9 for the groups receiving 0.75, 1.5, and 3.0 c.c. orange juice respectively. The relationship between dose and degree of protection is thus linear. In the case of vitamin D, as already stated, the linear relationship held between degree of healing and the logarithm of the dose. The authors found the response of individual guinea-pigs to be very variable. Consistent results could be obtained, however, when groups of five on each dose were employed. The method has the advantages of speed and of giving more precise results than that involving the determination of the minimum protective dose. The curve obtained can be employed as a standard of reference for the assay of materials containing vitamin C.

For the assay of vitamin A, which is usually tested by its growth-promoting power, a curve relating growth rate to dose given is required. It is possible that other methods may be developed in the future, for example, Coward has found that the number of rats dying when given small doses of the vitamin after a preliminary depletion period, during the second to fifth weeks of vitamin administration, is proportional to the dose given. The same observer has also published curves relating growth rate to dose of vitamin, from which it is possible to determine the potency of an unknown preparation in terms of a selected standard.<sup>3</sup>

It was found that the type of casein used in these tests played an essential part. A quantitative relationship between dose and growth was not obtainable when the casein used had first been heated. The synthetic diet was therefore prepared from 'light white casein', dextrinised rice starch, dried yeast, and a salt mixture. Small doses of vitamin D were given weekly or the diet was irradiated. The young rats were given this diet until they ceased to grow. They were then divided into groups, to each of which the same dose of cod liver oil was given daily by hand for five weeks. With doses ranging from 1 mgm to 7.5 mgm daily, the average growth rates varied from 2.0 gm to 10.0 gm per week for this period. The curve obtained by plotting growth against dose given was logarithmic in type; a simple formula could be fitted to it. It was later found that it could be resolved into two similar curves, one for the bucks and one for the does, the formulae for which are

$$y = 11.3 + 50.3 \log x \text{ (bucks) and } y = 12.4 + 27.4 \log x \text{ (does)}$$

where  $y$  is mean increase in weight of group in five weeks and  $x$  is dose of cod liver oil in milligrams

Analysis of the results showed that with five rats per dose the error is usually within fifty per cent, with ten, within thirty-three per cent, and with twenty, within three per cent. No seasonal variation in response was noted. The curve is used as a standard of reference in the assay of preparations of vitamin A. The growth responses to several doses of the latter are determined on groups of ten rats each and from the curve the doses of the standard cod liver oil which would have given such responses read off. The potency is proportional to the ratio of the dose of standard to that of the unknown at each level.

The necessity for an accurate biological test for vitamin A has been emphasised by some recent work on the possible chemical and physical characteristics of these vitamins.<sup>4</sup> It has been generally supposed that the blue colour given by an oil containing vitamin A with antimony trichloride is a good indication of its growth-promoting potency. The investigations of the above authors have now demonstrated that in cod liver oil at least two substances giving a blue colour are present. Comparative biological, chemical, and physical tests of a series of cod liver oils showed that the best agreement with the biological method was given by the measurement of the ultra-violet absorption band (at 3280 Å) of the oil itself, and also by that of the blue value of the unsaponifiable fraction of the oil. Less good agreement was obtained with the measurement of the intensities of the two bands present in the blue colour produced with antimony trichloride, while the least good agreement was shown by the measurement of the blue values of the oils themselves. In other experiments it has been shown that the intensity of the band at 5720 Å in the antimony trichloride test runs parallel with that of the band at 3280 Å in the oil. The intensity of the absorption at 6060 Å in the colour test shows no such relationship. This band appears to be due to the presence of another chromogen, its intensity is low in fresh oils but can be considerably increased by oxidation. It appears, therefore, that until the chemistry of vitamin A has been further elucidated, the final resort for its quantitative estimation must still be the biological test.

<sup>1</sup> "The Quantitative Estimation of Vitamin D by Radiography", by R. B. Bourdillon, H. M. Bruce, C. Fischmann, and T. A. Webster. Medical Research Council Special Report Series, No. 158. Pp. 46+2 plates. (London: H.M. Stationery Office, 1931) 1s net.

<sup>2</sup> *Biochem. J.*, vol. 25, p. 888, 1931.

<sup>3</sup> K. H. Coward, K. M. Key, F. J. Dyer, and B. G. E. Morgan. *ibid.*, vol. 24, p. 1952, 1930. vol. 25, p. 551, 1931.

<sup>4</sup> K. H. Coward, F. J. Dyer, R. A. Morton, and J. H. Gaddum. *ibid.*, vol. 25, p. 1102, J. A. Lovren and R. A. Morton. *ibid.*, pp. 1336 and 1341 (with R. H. Creed), A. E. Gillam and R. A. Morton. *ibid.*, p. 1346, I. M. Heilbron, A. E. Gillam, and R. A. Morton. *ibid.*, p. 1352.

### Climate of Southern Rhodesia \*

THE meteorological service of Southern Rhodesia is, of course, in its infancy. Nevertheless, for the period under review 46 climatological stations and 550 rainfall stations were available, a network sufficient to give a good idea of the course of the weather. For the purpose of obtaining a general survey of the rainfall, the element which is of paramount economic importance to agriculture in such a region, the Report states that a gauge to each 120 square miles is sufficient. Southern Rhodesia contains about 1200 such squares, and of these, 322 are at present occupied by gauges. Just as in the case of the British Isles, the rainfall observers are

practically all voluntary helpers in meteorological work.

Rhodesia is one of those countries where the figure representing the average rainfall of any part for a long period of years is in itself a very uncertain guide as to the suitability of that region for particular branches of agriculture. The principal reason for this is the great variability from year to year of the fall in any part of the rainy season, but to this must be added the fact that much of the rain is received in violent storms—often accompanied by thunder—and the rain, even when of reasonable amount as judged by weekly or monthly totals, may be to a great extent lost to agriculture through the rapidity of its 'run-off'. Some striking examples of abnormal

\* Southern Rhodesia. Meteorological Report for the year ended June 30, 1930, by the Department of Agriculture. Pp. 94. (Salisbury.)

rainfall are given in this Report for example, 2.05 inches in fifteen minutes at Riversdale (Charter) on March 7, 1930, and 6.50 inches in one hour at Lundi (Chibi) on Jan 18, 1930. The latter figure represents very nearly the normal total for the wettest quarter of the year in London. It is natural that every effort should be made to forecast the amount of rain to be expected in each rainy season, and for this purpose it appears that a trial is being made of an equation connecting the general rainfall of Southern Rhodesia with the Nile Flood, pressure at Rio Janeiro, temperature at Mauritius, and minimum temperature at Bulawayo. The necessary values of the independent variables are not available until early in December, they give a combined correlation coefficient of +0.77 only, which is rather low for forecasting purposes. For the season 1928-29 the forecast departure from normal was -1.2 inches, and the actual departure -1.9 inches. This matter is in the experimental stage, and consequently the forecast was not made public.

The Report contains a good deal of statistical matter relating to the period under review, most of which is in tabular form. There are excellent rain-

fall maps, giving the geographical distribution of the year's total and of the normal year's total, both of which illustrate the general tendency for rainfall to decrease with distance from the Indian Ocean. This is a well-recognised feature of most of British South Africa, due to the fact that, apart from local convectional storms in the spring and occasional rains due to tropical hurricanes out on the ocean in late summer or autumn, much of the season's fall is due to dynamical cooling of the south-east trades as they rise over the elevated plateau of South Africa, which winds naturally lose much of their moisture in this way as they penetrate into the interior. Climatic investigation is being extended into the upper atmosphere by means of observations of wind with the aid of pilot balloons liberated at Salisbury. Some of these were followed to a height of ten kilometres. At the higher levels, the predominance of easterly and south-easterly winds appears to be lost, both in summer and winter, at ten kilometres, the directions most favoured in 1929-30 being west and north-west. Since this work was only begun in October 1928, this is the first full year's observations of upper winds.

E. V. N.

### Glasgow Meeting of the Chemical Society

**H**OLDING its annual general meeting at Glasgow on March 17, the Chemical Society paid its first visit to Scotland. The choice was particularly appropriate in view of the association both of the president, Prof. G. G. Henderson, and of the Society's first president, Thomas Graham, with that city, moreover, as Sir Thomas Kelly said at the civic reception, the Corporation has a particular interest in chemistry, for they themselves are chemical manufacturers on a very large scale.

In his presidential address, Prof. G. G. Henderson dealt with a matter of pressing importance to all societies which essay to publish the results of scientific investigation, and one which at the present time occasions acute anxiety to those organisations which are nobly attempting to continue to finance an adequate service of abstract publications out of the subscriptions of their members. The burden has fallen very heavily on the Chemical Society. The chief work for which it exists has grown very considerably during the past year, the number of original communications published in the *Journal* is 24 per cent higher than in 1930, and the number of chemical papers abstracted by the Bureau and published in *British Chemical Abstracts* "A" is also very much greater than in the previous year. The consequent financial burden is too great for the Society, with its present income, to bear, and at no other period in its long history has the Society been faced with such great difficulties in carrying on its work.

It is, and always has been, the function of the Chemical Society to encourage the development of chemical science in all branches and to provide a regular and complete record of all new additions to chemical knowledge, nevertheless, it was the Society of Chemical Industry, inaugurated in 1881, which gave to technological chemistry the stimulus then lacking owing to the restricted resources of the older Society, and afterwards the development of other branches of the science has been fostered by the creation of specialist societies. "Looking back on what has happened since 1841," said Prof. Henderson, "the thought arises that if those of our predecessors who managed the affairs of the Chemical Society during the first forty years of its existence had taken a broader and a longer view, some at least of the various

societies to which I have referred might not have been founded, and we might now have one great chemical society, with a membership of 10,000 or more, with the members organised into divisions dealing with the different branches of chemistry and possessing a large measure of autonomy."

Possibly the suggestion that an endeavour should be made to bring about the merging into one organisation of all the various societies concerned with chemistry might be considered impracticable, but Prof. Henderson urged that no effort should be spared to promote the closest possible co-operation between them, so far as the Chemical Society and the Society of Chemical Industry are concerned, a very good case can be made out for reunion. Such a union would almost indubitably effect economies, and the proposal *ipso facto* merits consideration. Even if the difficulties which stand in the way of bringing about a complete fusion of interests prove to be too great, it should be as possible as it is desirable to arrange for a working partnership of the most intimate character.

An important step in that direction was taken in 1923, when the Bureau of Chemical Abstracts—a joint committee of the two societies responsible for the production and publication of *British Chemical Abstracts* "A" and "B"—was formed. Upon these two societies alone falls the financial burden of this great work, a task which is performed for the benefit of every chemist in the country. Prof. Henderson pointed out that it is singular and anomalous that there are hundreds, perhaps even thousands, of professional chemists in Great Britain who make no contribution to this burden, who do nothing to help the cause of chemistry in the way that is most urgent, most necessary, and most expensive. He appealed to all chemists to support one or both of the two Societies, even though the *Journals* may be consulted by non-members in the general and departmental libraries of practically all universities and colleges, in the libraries of many chemical works and scientific societies, and in a number of public libraries, and even though they rightly find it desirable to subscribe to professional organisations such as the Institute of Chemistry and the British Association of Chemists.



A large addition to the membership of the Chemical Society would assist in easing the situation, but income derived from annual subscriptions is always subject to fluctuations, and something more permanent is desirable. Prof Henderson appealed for additions to the Society's capital fund, which supports the publication of the results of original investigations in chemistry, and in particular suggested that the Institute of Chemistry might not find itself precluded by its charter from widening the range of its beneficent influence by giving a substantial annual contribution to the Publications Fund of the Chemical Society. Referring to co-operation with the Institute and the Society of Chemical Industry in another direction, Prof Henderson advocated the formation of local committees of fellows of the Chemical Society in each city where there is a section of the Institute or of the Society of Chemical Industry, in order that joint meetings might be arranged for the reading and discussion of papers.

Of the various suggestions which have been made for the reduction of expenditure, that which proposed the abolition of the Bureau of Chemical Abstracts and the purchase of copies of *Chemical Abstracts* from the American Chemical Society is not likely to appeal to either of the societies. Another suggestion which deserves consideration, but is attended with risk of loss of income without marked diminution in the cost of publication, involves the payment by fellows of a nominal subscription, additional payment being made for whatever publications they desire to receive. A direction in which a certain reduction of expenditure could be effected was indicated by Prof Henderson. There is a tendency towards the publication of the results of research work in more numerous instalments than was formerly the custom, each instalment requires introductory discussion, and repetition is almost inevitable. If authors published their results in a more limited number of more comprehensive papers and safeguarded priority by means of short communications, little if any loss would be suffered and valuable space would be saved.

The problems discussed by Prof Henderson are very real and their solution will be correspondingly difficult, nevertheless, it may be supposed that members of a great scientific community will approach them boldly and skilfully as a profession, and not sectionally or with hesitation, unity is strength, and success proverbially comes to the strong.

During his speech at the anniversary dinner after the meeting, Lord Weir referred to a matter of policy which has frequently been emphasised in the columns of *NATURE*—the status of science in politics and the nation's neglect to make adequate use of scientifically trained men in high places. The man of science must nowadays be mainly a specialist, accordingly, the politician or the so-called business man becomes the framer and controller of policy. While admitting great respect for both the politician and the business man, Lord Weir doubts whether sufficient use is made of the trained scientific intellect when the major lines of national policy are being decided upon. Experience has taught him, for example, that at no time should the Board of Admiralty, the Air Council, or the Army Council—any one of them—be without a member having scientific or engineering attainments, he referred to no question of status or recognition, but the simple wisdom of having representation of that type of brain. Whether or not this is a matter which can be appropriately pursued by the Chemical Society is for that organisation to determine, there can, however, be no two opinions concerning the place of exact knowledge and organised inquiry in the art and practice of government.

## University and Educational Intelligence

OXFORD —The School of Geography at Oxford was established, with the assistance of the Royal Geographical Society, in 1899. In 1921 it entered into possession of its present quarters in Mansfield Road, where lectures and practical and tutorial instruction are given and other geographical work is carried on. For some years past a diploma in geography has been granted by the University to qualified candidates, and it has lately been decided to raise geography to the status of a final honour school for the arts degree. A new professorship has been established, and the first holder of the chair will be Major Kenneth Mason, who has a distinguished record for service in France, Persia, India, Mesopotamia, and Central Asia. He will be an *ex officio* fellow of Hertford College. The conditions and regulations for the new honour school are not yet determined. Major Mason will take up his duties on May 1.

ST ANDREWS —The Senatus Academicus has agreed to confer the honorary degree of LL.D. upon the following, amongst others, on June 28: Sir James Frazer, Sir Richard Livingstone, vice-chancellor of the Queen's University of Belfast, Mr James Robb, secretary of the Carnegie Trust for the Universities of Scotland, Prof L. R. Sutherland, emeritus professor of pathology in the University of St. Andrews.

MR W. E. SHEWELL-COOPER, horticultural superintendent, Cheshire County Council, has been appointed horticultural superintendent at the Horticultural College, Swanley, and will take up his duties in July.

At the National Union of Teachers' annual conference at Folkestone, the president, Mr A. E. Henshall, of Stafford, protested energetically against the postponement of school building programmes, the employment of capacity tests for free places in secondary schools, and the 'cuts' in their salaries to which teachers have recently been subjected. The teachers of the country, he stated, continue to believe that they have been harshly and unjustly treated. As regards the services the teachers may be expected to render to the community, he directed attention to the difficulty of preparing pupils for life in a rapidly changing world, and suggested (somewhat optimistically) that the teacher can train them to seek to use their own powers, lead them to exercise initiative and to achieve self-reliance, and cultivate open-mindedness, intellectual curiosity, accuracy of thought, tolerance, and a sense of personal responsibility. The time has arrived, in Mr Henshall's opinion, for a reconsideration of the relation between school and workshop, for no education can be complete which disregards the need of earning a livelihood. Increased leisure, "the gift of science", must also be prepared for, and in the schools must be cultivated interest in those arts and crafts the practice of which demands only relatively easy technique but provides means of self-expression. The May Committee is blamed for checking progress in this direction.

UNTIL quite recently, science as a subject in a girl's education received scant attention. Towards the end of last century, if in the school curriculum at all, it consisted chiefly of descriptive botany and some geology. The method was therefore essentially didactic. At the beginning of the present century the pendulum began swinging in the other direction and laboratory work was initiated. A preliminary drilling in physical measurements formed the basis of this scientific way of obtaining knowledge by personal observation and experimentation, but this heuristic

method proved to be very slow. As Miss I. M. Drummond, former president of the Association of Women Science Teachers, points out (Association of Women Science Teachers, Report for 1931), it is impossible to force ontogeny to repeat phylogeny in educational method. Progress by such a method would be tedious and defeat its own ends. It is necessary to keep in view the sciences and the greatness of scientific conceptions. The practical method is still essential, and experiments, while they are a means of illustration, should not be treated merely as such, but rather as the basis of the lessons. Thus results would come as surprises, and force the individual to trust her own powers of observation. Training in accurate expression, too, comes via the laboratory practical notebook. Teachers have in their hands an instrument of pre-eminent value for training real integrity of the mind. The cultural value of science can be brought out through its past glories. The history of science has a twofold value in endowing science with a human interest and enabling our people to cultivate the mental equipment necessary for the present-day scientific atmosphere of thought.

### Calendar of Geographical Exploration

#### April 4, 1931—Haardt's Last Journey

M. Georges Marie Haardt, the famous French explorer, set out from Beirut, Syria, on an attempt to cross Asia by motor car. The journey was successfully accomplished, and Peking reached on Feb. 12, 1932, but the explorer contracted pneumonia and died at Hong Kong in March. Iraq, Afghanistan, the Indus valley, and the Pamirs were traversed, but travel by motor had to be abandoned after ascending the Bourzil Pass to 13,775 ft., the heavy rains compelling the party to take to ponies and yaks. In one place the motors had to be taken to pieces and reassembled, in order to avoid the effects of a landslide. M. Haardt had made many previous overland journeys, the most famous being the crossing of the Sahara in 1922-23, which resulted in the opening up of new routes between Algeria and the Niger.

#### April 5, 1752—South-East Africa

An expedition led by A. F. Beutler, and including among its members two surveyors and a botanist, reached the last settlement towards the east from Mossel Bay, just beyond the Little Brak River. Keeping near the coast, the party explored the shores of Algoa Bay, crossed the Great Fish River, and arrived at the Keiskama River, which then formed the boundary between the Hottentot and Bantu peoples. The Kei River was crossed, but the fatigue of the party then made return necessary. A different route was taken, and much new country, including the valley of the Fish River, was explored.

#### April 6, 1682—The Mississippi Delta

Robert Cavelier de la Salle reached the Mississippi delta. La Salle went to Canada in 1666, and in 1669 began his famous series of explorations by discovering the Falls of Niagara and the Ohio River. The discovery of the Mississippi River was made by Joliet and Marquette, who reached it via the Wisconsin, but turned back near its confluence with the Arkansas. La Salle, with two companions, set out in December 1681 from Fort Miami, descended the Illinois in canoes, and reached the Mississippi in February 1682. On April 6, when they reached the head of the great delta, each of them sailed down a separate arm and met later in the Gulf of Mexico. In July 1684, La Salle attempted to reach the delta by sea, but landed

in the lagoons of Texas, 400 miles from it. His store ship and its companion vessel were wrecked. An attempt to lead his discontented party overland resulted in the murder of La Salle and three others of the party in the plans of Texas, before the valley of the Mississippi was reached.

#### April 6, 1909—The North Pole Reached

R. E. Peary, the American Arctic explorer, reached the north pole, accompanied by the negro Henson and by four Eskimos. They remained there about thirty hours, and in a sounding a few miles from the pole found no bottom at 1500 fathoms. Peary started on this journey in 1908, wintered in Grant Land, and set out over the ice from Cape Columbia on March 1, 1909. A party of six set out and were gradually sent back as supplies diminished, Bartlett turning back at 87° 48' N. Peary began his work in 1886, when he made a study of Disco Bay on the west coast of Greenland as a possible base for polar exploration. In 1891 he undertook a polar expedition, his wife accompanying him, and in 1892 reached the north-east coast of Greenland, thus proving it to be an island. Studies were also made of Smith Sound Eskimo tribes. In 1902 Peary and Henson reached 84° 17' N., and in 1906 Peary and his companions reached 87° 6', but were compelled to return at that point. His success in 1909 crowned twenty-three years of continued effort.

### Societies and Academies

#### LONDON

Society of Public Analysts, Feb. 3.—N. L. Allport and G. H. Skrimshire. A new method for the determination of lead in organic substances, with special reference to dyestuffs. The organic material is destroyed by wet oxidation and the lead is removed by shaking with a chloroform solution of diphenylthiocarbazone. Finally the lead is determined colorimetrically as sulphide. The method is applicable in the presence of large amounts of iron, but bismuth interferes with the method, and special procedures are necessary when appreciable amounts of tin, aluminium, nickel, or cobalt are present.—B. S. Evans. (1) Some analytical applications of sodium hydrosulphide. A rapid and accurate method is described of separating tin from various other metals the sulphides of which are soluble in alkali cyanide. (2) A rapid method of dissolving lead alloys preparatory to the determination of tin and antimony. Lead dissolves rapidly and completely in a mixture of perchloric and phosphoric acids, whilst tin and antimony form insoluble compounds which are apparently of the nature of 'metastannic' and 'metantimonic' acids.—H. B. Dunnick and H. D. Suri. The phloroglucinol method for the determination of mechanical wood pulp in paper. The phloroglucinol method of Cross and Bevan was found to be unreliable in India, and the authors have therefore studied the effect of temperature on the results, the relationship between the volume of standard reagent and the weight of paper for quantitative reactions, the time required, and the mechanism of the reaction.—E. H. Bunce. Investigations relating to milk standards under the Burma Food and Drugs Act. There are no legal standards for milk in Burma, but in the Government Laboratory a minimum of 3 per cent of fat and 8.5 per cent of solids-not-fat is adopted for cow's milk, and a minimum of 5 per cent for fat and 9.0 per cent for solids-not-fat for buffalo's milk. A common fraud is the dilution of buffalo milk with water to imitate cow's milk.

## DUBLIN

Royal Irish Academy, Jan 25.—J. J. Nolan and J. G. O'Keeffe Electric discharge from water drops. The negative discharge from drops originally hemispherical exceeds the positive for the same field values. Rapid discharge for drops of radius  $r$  exposed to a uniform field  $F$  begins for values of the field given by the approximate relation  $F\sqrt{r} = 3600$ , the units being volt and centimetre. In a pure atmosphere the ions produced by the discharge remain small ions.

## PARIS

Academy of Sciences, Feb 15.—B. Bang was elected *Correspondant* for the Section of Rural Economy.—Bertrand Gambier The points of contact of an algebraic curve and its envelope.—Gaston Julia The prolongation of a Riemann  $\sigma$  surface corresponding to a multiple convex area  $\mathcal{Q}$ .—N. Théodoresco The employment of Hadamard's method in the solution of Cauchy's problem for certain systems of partial differential equations.—René de Possel Ensembles of the maximum type and the prolongation of Riemann surfaces.—Henri Milloux An inequality of the theory of functions and its applications.—Jean Louis Destouches The integration of the equation with the first integrals of quantum mechanics.—André Coyne A new method of testing concrete or reinforced concrete works, especially barrages, by means of sound. A stretched steel wire is fixed between two points, by an electromagnetic arrangement and amplifying valves, any change in the distance between the two fixed ends of the wire can be measured in terms of beats heard in a telephone, the note emitted by the wire being compared with a standard tuning-fork. Numerous problems of interest to which this method can be applied are indicated.—Edmond Brun and Pierre Vernotte The heating of a thermometer by a gaseous current. Aerodynamical applications. The heating observed is the quotient of two complex phenomena, friction and convection. A theoretical formula is developed which gives a rise of temperature of the same order as that actually measured.—M. Mendes The problem of  $n$  bodies with variable masses.—A. Portevin and P. Bastien The principal factors affecting the flow of pure metals. The flow is the resultant of several complex factors, in which the calorific properties (specific heat, latent heat, melting point) of the metals are at least as important as the viscosity.—G. Reboul A particular form of activity of matter. Study of the action of various substances on a photographic plate.—Marcel Dufour The suppression of astigmatism in oblique pencils in thin lenses.—J. Gilles The relations between the quadruplets corresponding to N(I), O(II), S(II), and Cl(III).—E. Stahel The number of the secondary  $\beta$ -rays emitted by radium. For every 100 atoms decomposed, 5 secondary  $\beta$ -rays are emitted. This leads to the unexpected conclusion that the greater part of the radium atoms decompose without emitting  $\gamma$ -rays (see also NATURE, Feb 27, p 314).—E. Calvet The velocities and heats of saponification of the amides.—Adrien Karl The estimation of radium in the presence of the sulphates of the alkaline earths. The radium barium sulphate is heated with the eutectic mixture of sodium, potassium, and lithium chlorides to a temperature just above the melting point ( $520^\circ\text{C}$ ). No vapours are given off, and the emanation can be readily removed in a current of air.—Jarry The extraction of the phenols in tar oils by liquid ammonia. A mixture of tar oil and liquid ammonia separates rapidly into two layers: the upper layer contains the whole of the phenols.—Marcel Godchot and Max Mousseron Some new piperazine derivatives.—S. Sabetay and D. N. Mira Some ether

oxide aldehydes.—L. Royer New observations on the orientation of crystals deposited in contact with a cleavage of mica or chlorite.—F. Dupré la Tour Studies on the dimorphism in the normal saturated fatty diacid series as a function of the temperature.—M. G. Filipesco The siliceous accidents of the Tisara strata (Flysch of the Roumanian Carpathians).—Dalloni The volcanoes of Tibesti.—André Demay The conditions of orogenesis and of Hercynian metamorphism in the eastern edge of the central massif between Saint-Vallier and Privas.—Ch. Gérard A Liassic fauna of Sierra Sagra, in the sub-betic zone (southern Spain).—G. Corroy The Toarcian of Lorraine and of Haute-Savoie. The recurrence of the schistose facies at Posidonomyes.—Antonin Lanquine The extension of the facies and fauna of the Argovian in the Provençal chains.—Mlle Lucienne George Observations on *Sorbus aria*.—J. Dufrenoy Correlation between the air temperature and rate of growth of the vine.—L. Grigorakis The morphology and evolutionary cycle of the Actinomyces.—H. Colin and P. Ricard *Pelvetia canaliculata* as a source of l-fucose.—Émile Andre and Kiawo Hou The presence of a lipide oxidase or lipoxidase in the seed of *Glycine soja*.—Marcille Life in a confined medium. Protection against poison gas.—Mme L. Randoin and Mlle A. Michaux Variation of the amount of sodium and potassium in striated muscle under the influence of a diet entirely deprived of the antiscorbutic vitamin. The absence of vitamin C from the diet causes an increase of the sodium and chlorine in the muscle and a reduction of the potassium.—Raymond-Hamet The action of acetylcholine on the vasomotors of the penis in the dog.—H. Bierry and B. Gouzon The fluorescent substances of egg-shell.—Étienne Rabaud The rôle of the *stabilimentum* in the webs of *Argiope bruennichi*.—Mlle Yvonne Garreau and J. Parrot The oxidation products of *d*-galactose by ammoniacal copper oxide and the oxygen of the air, at laboratory temperature.—G. Delamare and C. Gatti The rounded bodies of *T. dentrum*.—C. Levaditi and N. Constantinesco Syphilis and neoplasms.

## VIENNA

Academy of Sciences, Nov 11.—R. Weiss and C. Alberti The action of benzyl magnesium chloride on benzal phthalide. (2) Preparation of *o*-phenylenebis-(phenylglyoxal).—K. H. Berg Cytological observations on *Aegilops truncialis*  $\times$  *Secale cereale*.—K. H. Berg A hybrid with four complete haploid species-genomes.—A. Winkler Preliminary report on studies in the Tertiary on the north-east spur of the central Alps.

Nov 19.—R. Weiss and A. Abeles The separation of racemates into their optically active components by means of addition-compounds.—H. Bojko The ecology of *Cynodon dactylon* and *Astragalus exscapus*.—A. Kohler Geological and petrographic investigations on the primitive rocks of the Lower Austrian Waldviertel and its boundary regions. Second report. Two new analyses of granites.—K. Girkmann Dimensions of girder frameworks on the assumption of an ideal plastic steel.—M. Mladenovic Elemic acid from Manila elemi resin. (4) Dihydro-elemolic acid and its derivatives.—K. Cori and B. Finzi Enumeration of the ants collected by K. Cori on the South Dalmatian islands in 1914.—E. Holesch The evaporation of radium-*B* and radium-*C* in hydrogen and nitrogen.

Nov 26.—F. Ackerl The gravitational field of force of the earth. A map has been prepared with lines of equal force.—F. Kuba Centric crank oscillations.—L. Kolbl Tectonic of the Tauern 'fenster'.—H. Y. Graben Report on geological and petro-

graphic researches in the Upper Austrian primitive rocks—M Sellnick Zoological expedition to the Ionian Islands and the Peloponnesus (10) Acari—A. Zinke and O Benndorf Perylene and its derivatives (34) The hydration of perylene—Eder, Spath, and Wegscheider Commission report concerning the discovery of red phosphorus There have been two claimants, Dr J Goldmark and Prof A Schrotter Schrotter's experiments began in 1845 Goldmark was a student in Schrotter's laboratory between 1845 and 1847 Goldmark lectured on red phosphorus in August 1847 at Oedenburg in Hungary Schrotter's first announcement was to the Vienna Academy in November 1847, published in December 1847. The commission awards priority to Schrotter.

### Forthcoming Events

#### FRIDAY, APRIL 1

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (Annual General Meeting) (at Engineers' Club, Manchester), at 7—F J Slee. Laboratory Tests of Lubricants and their Relation to Engine Tests (Lecture)  
MANCHESTER ASSOCIATION OF ENGINEERS (Annual General Meeting) (at Engineers' Club, Manchester), at 7—W Core Layout of Machines and Small Tools for Economical Production

#### MONDAY, APRIL 4

ROYAL INSTITUTION OF GREAT BRITAIN, at 5—General Meeting  
INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (Annual General Meeting) (at Birmingham University), at 7—E A E Woodward and W A Carne An Analysis of the Costs of Electricity Supply and its Application in Relation to Various Types of Consumers  
SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Royal Institution), at 8—Sir William Bragg and Dr G Shearer The Application of X-Rays to Chemical Industry (Lecture)

#### TUESDAY, APRIL 5

ROYAL ANTHROPOLOGICAL INSTITUTE (African Research Committee), at 5 30—Culture Distribution Maps for Africa  
LONDON NATURAL HISTORY SOCIETY (at London School of Hygiene and Tropical Medicine), at 6 30—Prof M Culpin Heredity and Disease (Bacot Memorial Lecture)

#### WEDNESDAY, APRIL 6

ROYAL SOCIETY OF ARTS, at 8—Dr F H Constable Light Sensitive Cells in the Service of Man (Lecture)

#### THURSDAY, APRIL 7

INSTITUTION OF CIVIL ENGINEERS, at 6—To consider a Provisional Report of a Sub-Committee of the Institution on the Drafting of Bills of Engineering Quantities, together with a List of the Units of Measurement to be Employed

#### FRIDAY, APRIL 8

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4 30—Sir Richard Burn Recent Developments in Land Revenue and Rent Policy in the United Provinces (Lecture)  
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Royal Victoria Hotel, Sheffield), at 6—T G Elliot and Dr W Cullen Special Alloy Steels as applied to Chemical Engineering  
INSTITUTE OF FUEL (East Midlands Section) (Annual General Meeting) (at University College, Nottingham), at 7 15—V B Harley-Mason Conditioning of Boiler Feed Water  
SOCIETY OF DYERS AND COLOURISTS (Scottish Section) (Annual General Meeting) (at George Hotel, Glasgow), at 7 15—J Muir Some Notes on pH Control by Colorimetric Methods (with demonstrations)

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OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at College of Technology, Manchester)—Annual Meeting.

#### APRIL 8 TO 11

CONGRESS OF GERMAN PHARMACOLOGICAL SOCIETY (at Wiesbaden)

#### APRIL 11 TO 14

CONGRESS OF GERMAN SOCIETY FOR INTERNAL MEDICINE (at Wiesbaden).

### Official Publications Received

#### BRITISH

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1436 (Strut 50) Torsional Loading on Stripped Aeroplane Wings By Dr H Roxbee Cox Pp 12+2 plates (London H M Stationery Office) 9d net  
The Imperial Council of Agricultural Research Scientific Monograph No 1 The Fungi of India By Dr E J Butler and Dr G R Bisby. Pp xviii+237 (Calcutta Government of India Central Publication Branch) 6 12 rupees, 11s  
The Indian Forest Records Silviculture Series, Vol 16, Part 6 The Use of Stumps (Root and Shoot Cuttings) in Artificial Regeneration By H G Champion and B D Pant Pp vi+89+8 plates (Calcutta Government of India Central Publication Branch) 2 4 rupees, 4s 8d  
Journal of the Indian Institute of Science Vol 14A, Part 10 The Reactivity of Dimethyldihydroresorcin Part 2 Behaviour towards Ortho Nitro and Ortho Aminobenzaldehydes By B H Iyer and G C Chakravarti Pp 157-171 (Bangalore) 1 rupee  
Tanganyika Territory Geological Survey Department Annual Report, 1930 By Dr E O Teale Pp ii+34 2s 6d Short Paper No 9 Shinyanga Diamond Fields By Dr E O Teale Pp iii+39 4s (Dar es Salaam Government Printer)  
Scientific Reports of the Imperial Institute of Agricultural Research, Pusa (including the Reports of the Imperial Dairy Expert, Physiological Chemist, Government Sugarcane Expert, and Secretary, Sugar Bureau), 1930-31 Pp iv+150+3 plates (Calcutta Government of India Central Publication Branch) 2 6 rupees, 4s 3d

#### FOREIGN

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 84. Additional New Birds from Peru with a Synopsis of the Races of *Hylophylax naevia* By M A Carraker, Jr Pp 7 Geographical Variation in *Trachyphonus margaritatus* By W Wedgwood Bowen Pp 9 10 (Philadelphia)  
Publications of the Lick Observatory Vol 17 Part 1 A Study of the Solar Chromosphere based upon Photographs of the Flash Spectrum taken by Dr William Wallace Campbell, Director of the Lick Observatory, at the Total Eclipses of the Sun in 1898, 1900, 1905 and 1908, by Donald H Menzel, Part 2 Halley's Comet in its Apparition of 1909-1911, by Nicholas T Bobrovnikoff Pp v+vi+482+21 plates (Berkeley, Calif University of California Press)  
University of California Publications in American Archaeology and Ethnology Vol 29, No 3 The Southeastern Yavapai By E W Gifford Pp iv+177-252+plates 29 35 1 dollar Vol 32, No 1 Yurok Karok Basket Weavers By Lila M O'Neale Pp ii+184+58 plates 4 50 dollars Vol 32, No 2 Primitive Concepts of Disease By Forrest E Clements Pp iii+185 252 75 cents (Berkeley, Calif University of California Press)  
Annuaire de l'Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique, 1932 98<sup>e</sup> année Pp 198+2 planches (Bruxelles Maurice Lamertin)  
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## Race and Creed in the Problems of India

SINCE our issue of Jan 23, when the problem of India was last the subject of comment in these columns, the progress of events has been far from reassuring. It is no exaggeration to say that the results of the deliberations of recent years seem to be well on the way to the melting-pot. It is true that the pledge of Britain to India to press on constitutional reform still stands, but India, on its side, has made little contribution towards a settlement. The problem of the communities remains unsolved, yet this is the problem for which, it has been laid down, a satisfactory solution must be found in the settlement of the franchise as a pivotal and precedent condition of all reform.

When the delegates to the Round Table Conference returned to India, early in the year, they felt able to speak with some assurance of the possibilities of reform. They were inspired with a confidence born from the expressions of goodwill to which they had listened in London. That confidence has now vanished, and it has vanished at the bidding of their own people. It is apparent that there is little inclination in India towards that compromise between diverse interests which, with all the goodwill in the world, is inevitable in any formula of government that aims at securing a justly representative character in the institutions it regulates. The course of affairs in India is again approaching a deadlock.

It must be pointed out once more—and apparently it cannot be pointed out too often—that the situation in India, which becomes a deadlock when an attempt is made to come to grips with practical measures, is not a political crisis which can be resolved on the lines of compromise and arrangement possible in a western civilisation. The attempt to mould the oriental mind to western ideals has produced the present difficulties in India, those ideals have not permeated Indian life and thought to the degree necessary to make it possible to deal with these difficulties on western lines. Social and political compromise as the result of a voluntary approach one to another, which is of the essence of western political life, is impossible between race and creed in India.

To admit this factor in the situation is not necessarily to adopt a counsel of despair, but it is necessary that it should be clearly understood. The spectacle of a united but shackled India, debarred from self-government by the British *raj*, has vanished. The British Government has declared its willingness—and even India must

admit its sincerity—to grant self-government to the Indian people. It is the Indian peoples themselves who stand in the way. Their attitude of mind is not one that is readily comprehensible to the average western; but it is from the point of view of the oriental mind that the problem must be attacked. Notwithstanding India's advanced civilisation and the long history of its culture, the problems of its government must be studied by its administrators, and by those who ultimately will have to submit its fate to the arbitrament of the British Parliament and the British people, in the light of principles formulated by anthropological science and after consideration from the trained and sympathetic point of view of the anthropologist, just as much as the social organisation and the religious beliefs of the Negro races have been studied and taken into account in the administration of West African affairs. India must be governed according to Indian ideas, but not the ideas acquired by a western veneer.

What are the racial or sectarian ingredients of the problem? Hindus, Sikhs, Moslems, all are animated by an antagonism one to another, which is capable at any moment of bursting into a flame, all the more intense because it is nearly akin to religious fanaticism. The recently issued report on the trouble between Hindu and Moslem in Kashmir describes the latest and by no means the least disturbing of these outbreaks—disturbing not merely on account of its extent, but also because it is one of a series of disturbances differing in character from the faction fights in which Moslems previously had been concerned. Hitherto, at periods of political difficulty and stress affecting the Moslem communities, the authorities had always been able to rely on their loyalty. They can rely upon them no longer.

To this list of inflammable material must now be added the outcastes, and above all, the untouchables, the depressed classes, bitterly resentful of the attitude of the castes—Hindus, who ostracise them, while at the same time claiming, for political reasons, that they must count as Hindus without rights to separate consideration. Each of these groups, however, is vocal. It may hope for an expression of its views and aspirations, if only after filtration through a disproportionately small selection of its numbers. But what of those who are classified by the Census authorities as animists, the wild tribes who fit into no category, but whose beliefs and whose village godlings are slowly being assimilated to the Hindu pantheon? Are they to be absorbed into the Hindu community? Their

claims are least likely to be heard, yet to the scientifically trained observer their institutions and their beliefs demand the most careful consideration, lest injustice may follow under even the most benevolent of administrations.

Each of these sectional interests has its own traditions and its own outlook, to which deference must be paid. A recent case which has attracted much attention may serve to illustrate the pitfalls of action and reaction between these sectional differences in outlook. This is the case of the two Moslem youths condemned to death for the murder of a Hindu bookseller. The exaggerated and highly inflamed state of sectarian feeling was, no doubt, largely responsible for their act, but its immediate cause was the fact that the bookseller had displayed a portrait of the Prophet in his store. This was a gross offence to the Moslem creed. In this connexion the incident carries its own moral and needs no elaboration.

It cannot be said that the situation has been seriously affected in an adverse sense by the drastic action of the executive in the suppression of disorder. In fact, the result, on the whole, has been rather the reverse. The ingrained inclination of the Oriental to hold in respect the strong hand, without too much regard to the motives with which it is exercised, has tended to weaken the position of the Indian Congress. Especially is this apparent in rural areas. Here, indeed, the position of the Congress was by no means too strong. Although its propaganda among the peasant cultivators was a serious source of danger, the 'no dues' campaign and the claim to decide upon the readjustment of terms of land tenure were, naturally, by no means so popular among the landholders as they were among the peasants. The fact that an 'unofficial' pamphlet advising the payment of government dues, which has been circulated among the peasant tenants in one area, has not been repudiated is surely indicative of a weakening in the position of the Congress.

In the meantime, the attitude of the native princes has not been without its effect in obscuring counsel. Their acceptance of the principle of adherence to an 'All-India' federation appears to have been by no means so generally agreed among them as was stated, and the pending election of a chancellor of the Chamber of Princes added a measure of uncertainty as to their ultimate decision. After a period of vacillation, it became apparent that they had in mind a degree of co-operation in a federated India as essential to their interests, though it was by no means evident that



they had any very clear idea as to the form or extent of their adherence. Discussion of the report, which had been prepared for the consideration of the Chamber, evoked something more nearly approaching the nature of a definite policy. At the time of writing it seems possible, however, that they will for the present go little beyond their original expression of adherence, subject to the safeguarding by the Crown of all treaty rights and rights of internal sovereignty. Once more the real difficulty, as always in India, that of practical detail, is likely to be left untouched.

All things considered, the work of the advisory committees, from which so much was expected, has not been pursued in the happiest of circumstances. It was thought that, while they considered specific problems on the spot, intimate contact with local conditions would assist them in arriving at their decisions. Unfortunately, it has proved once more that distance not only lends enchantment but also adds perspective. Quite early in the discussions it became evident that there was a strong inclination among the Indian members of the committees to refer back the more difficult problems for consideration and decision in London. The Consultative Committee, in fact, when it adjourned late in February, pending the submission of reports from the other committees, had accomplished little.

So far as one of the committees is concerned, the Franchise Committee, it is evident that delay is inevitable before the report can be considered. An attempt was made to stampede the Moslem Congress, which was held at Lahore on March 21, into a boycott of the Round Table Conference and the withdrawal of the Moslem delegates, on the ground that towards the end of February the Moslems had asked Lord Willingdon to submit the communal question to the British Government for decision, in view of the impossibility of arriving at a solution in India, but that apparently nothing had been done. Actually the request had been transmitted to the British Government by the Consultative Committee through the Governor-General, and an announcement was issued at Delhi on March 19 by the British Government, acknowledging with regret the notification of the Consultative Committee and reiterating the statement made in December last that, in the event of no communal agreement being reached, this failure would not be allowed to stand in the way of reform and a provisional solution would be imposed by the British Government from above. Although the Moslem Congress was by no means united, and

the action taken was due to the more extreme members, in view of this announcement it was decided that the matter of the boycott should not be pressed, at least for the present.

Once more the ball rests with Great Britain. It cannot but be felt that the occasion, if on one hand an embarrassment, on the other offers a great opportunity. The Government, it is true, has nothing in the nature of a mandate from India, but it has behind it the cogency of facts and the request of a not inconsiderable section of the community—in influence, if not in numbers. It is justified in taking the view that, in dealing with a practical problem such as the communal question, the political sense of the Indian peoples has proved itself utterly sterile. The natives of India, like other oriental peoples, can appreciate and render loyalty to a strong leader, they understand and accept domination of the weaker by the strong, provided the policy of non-interference with custom and belief is followed. They do not as yet understand, and cannot yet of their own initiative contribute towards, a settlement on the give-and-take lines of western democracy. The imposition of a settlement from above, however provisional in character, and always assuming that its adoption and observance are pressed with firmness, will constitute a greater advance towards the ultimate reform than all the endless and fruitless discussions by which an attempt has been made to elicit a common denominator for the aspirations of the people themselves. Stress has sometimes been laid on the measure of success in administration achieved in present conditions. This very fact is not without its significance, for it has been achieved under the ægis of restraining authority, which has given to sectarian feeling the balance it has not been able to attain by itself.

India, it may be recalled, is a great and growing industrial and commercial community. While this complicates, it does not alter the fundamental character of the problem. Its solution lies not with the urban but with the rural population, to which the predominant number of the Indian peoples belong. Reform will come not from above by the imposition of western institutions in the hope that their influence will permeate downwards, but by building up from below, by the careful scientific study of village institutions and their gradual modification to meet the strain of changing conditions as standards change, as change they must inevitably in the end. To take the first step in this direction the British Government has now been given the opportunity and the occasion.

### Berkeleyan Biology

*The Philosophical Basis of Biology* *Donnellan Lectures, University of Dublin, 1930* By Prof J S Haldane. Pp x+169 (London Hodder and Stoughton, Ltd, 1931) 7s 6d net

PROF J S HALDANE'S Donnellan lectures at Trinity College, Dublin, are here offered to the public in the form of a small book of some 170 pages. Biologists will read them with that extraordinary mixture of admiration for the author and exasperation at his views which they have now long been accustomed to experience.

The book is divided into three sections, the first of which bears the challenging title "The Axiom of Biology". As Berkeley inquired whether there is any meaning in the physical universe apart from its being perceived, so Prof Haldane wishes to inquire whether any meaning can be attached to the concept of an organism apart from its environment. It is obvious, he says, that in the biological sciences we are always making use of words such as 'function', 'organ', 'species', which are quite peculiar to biology and have no analogy in the physico-chemical sciences. These words cover a residuum (the major part of biology) for which no physico-chemical description has ever been found. Indeed, "the more we discover as to physiological activity and inheritance, the more difficult does it become to imagine any physical or chemical description or explanation which could in any way cover the facts of persistent co-ordination" (p 12). We cannot separate organic from environmental structure, for no sharp line of demarcation can be drawn between the organism and the environment. So we come to Prof Haldane's axiom: "The active maintenance of normal and specific structure is what we call life, and the perception of it is the perception of life. The existence of life as such is thus the axiom on which scientific biology depends".

It seems profitless to criticise this point of view, for scarcely any modification has taken place in Prof Haldane's opinions since the days of his paper in Andrew Seth's collaborative "Essays in Philosophical Criticism" (1883). His brilliant physiological researches have been carried on side by side with an attitude to biological phenomena which can only be likened to that of Frascatorius of Verona—"The heart's motion God alone can comprehend". Time after time Prof Haldane in these lectures appeals to the argument from inconceivability, thus joining hands with a thinker from whom he is usually careful to dissociate himself,

namely, Prof Hans Driesch. With respect to environment, his demand for the unification of organism and surroundings is surely a methodologically impossible aim, for if no line can be drawn between organism and immediate surroundings, no better line can be drawn between immediate surroundings and far-off surroundings. Biology is thus brought under the rule not only of Berkeley but also of Plotinus, and we are invited to contemplate the whole universe in its axiomatic wholeness, analysis of living things being laid aside.

The solid foundation for Prof Haldane's position, the real burden of his emphasis during so many years, is of course that the problem of organisation is the central problem of biology. "When we discover, for instance", he says on p 79, "the existence of an intraprotoplasmic enzyme or other substance on which life depends, we are at the same time faced by the question how this particular substance is present at the right time and place, and reacts to the right amount to fulfil its normal functions". Or again (p 16), "Physical or chemical mechanisms within the living body are actively maintained at the right places and in the right functional states". But to take organisation in biology as axiomatic is as fruitless as it would be to take the chemical elements as axiomatic in physics, and to make no attempt to go behind the periodic table into the realm of the electronic structure of atoms.

It is, no doubt, metaphysically true to say with Dr Tennant, that "the illogical core of the world is not a mere residuum of haze which science, when ideally perfect, shall have dissipated", the arbitrariness of the universe is indeed irremediable, but the worst mistake that can be made in scientific methodology is to introduce this arbitrary element at a higher level than absolutely necessary. If we take living organisation as axiomatic, that is, as an essential part of the impenetrable illogical core of the world, we at once discourage such investigations as the X-ray analysis of the relation of protein molecules one to another, which seems at present so likely to afford us an insight into the mechanism of cytoplasmic differentiation. Can we suppose that the students of colloidal physics have as yet said their last word (or even their first word) on the subject of protoplasm? The sublime expression "I am that I am" is well suited to the manifestation of a deity, but when applied to the immediate problems confronting scientific workers, its use becomes nothing more than the frank confession of intellectual bankruptcy.

Characteristic of Prof Haldane's self-contradictory position is the contradiction between p 11 and p 22. On p 11 we are told that the central facts relating to the specificity of a species are part of the residuum which physico-chemical biology is powerless to touch. Yet on p 22 "the constitution of proteins, including hæmoglobin, which can be separated from the bodies of different individual men, varies appreciably between different individuals, and this is no mere accidental circumstance, but is as characteristic for the individual as the shape or size of his hands or face, or the colour of his hair." Two thinkers struggle perpetually for the possession of Prof Haldane: one, the exact biologist, full of desire for the metrical description of phenomena, and for their causal explanation; the other, the idealist philosopher, primarily concerned with making the world safe for the spirit, and not averse from immediate appeals upon emergent occasions to the illogical core of the universe. It is for failure to differentiate between the two constituents of this dual personality that successive generations of biologists have been vexed and irritated by the counsels of one of the greatest among them.

One of the points upon which Prof Haldane lays much emphasis in these lectures is the fact that the assumed basic conceptions of Newtonian physics have been shown not to be in reality basic, and that instead we are presented with facts (for example, the intense co-ordinated specific activity within the atom, which does not become dissipated in its environment, and upon which its mass and other properties depend) which bear some resemblance to those with which biologists are familiar. This is undoubtedly very important, and no one is yet in a position to say what the influence of the quantum theory and wave mechanics may be upon biology, but Prof Haldane, curiously blind to these possibilities, can only infer from the breakdown of Newtonian physics the breakdown of physico-chemical biology. To more unbiased observers, the vanishing crudeness of chemistry seems to make the future of biochemistry all the more hopeful.

Another matter upon which Prof Haldane has a methodological theory all his own is the omission of 'essential' facts from scientific hypotheses. "Consciousness", he writes on p 87, "can certainly be treated from a purely mechanistic standpoint if we pay no attention to essential facts, just as other sides of physiology can be so treated when essential facts are left out of account." The only thing lacking here is a definition of the word

'essential', and there seems no logical distinction between Prof Haldane's position and that of a theologian who would object to the discussion of consciousness without reference to the facts of religious experience. This leads to an underestimate of the work of Prof Pavlov and his school, as several students of Prof Haldane's writings have recently remarked. To make use of an Eddingtonian phrase, when Prof Haldane says "mind" he means "mind (loud and prolonged applause)", that is, "mind" in the sense of Berkeley and Bosanquet, not in that of Herrick and Pavlov.

At the conclusion of his book, Prof Haldane devotes a special appendix to the discussion of Mr Woodger's "Biological Principles", Dr Russell's "Interpretation of Development and Heredity", and Prof Hogben's "The Nature of Living Matter". On the last named he pronounces an expected excommunication, on the second he sets the seal of probable orthodoxy, and the first he lays aside as a doubtful case, with a recommendation to mercy. It would scarcely be possible here to criticise the critic, and a mere reference to the appendix must suffice.

Prof Haldane is assured of an honourable place in the history of biology in the late nineteenth and early twentieth centuries. But this will always be in spite of, and not because of, his presentation of his case. It will be said of him that he took biological organisation seriously when no other biologist would, but perhaps this recalcitrance on the part of his colleagues was partly due to his own inability to distinguish between the conflicting claims of science and philosophy, and, we may add, of religion also.

JOSEPH NEEDHAM

### Technical Education in the Soviet Union

*Industry and Education in Soviet Russia*. By J. G. Crowther. Pp xi+94+16 plates. (London. W. Heinemann, Ltd, 1932) 7s 6d net.

WITH the publication of his "Outline of the Universe", J. G. Crowther may be said to have arrived as a writer of popular science. Contemporary writers on science for the general public expound their views on the assumption that the layman can be beguiled into an anæmic interest in the discoveries of scientific workers, if first convinced that nothing he learns will be likely to compel him to revise a neolithic ideology. With the elder Huxley, Mr Crowther holds that scientific progress is most interesting to the layman when, and because, it does challenge his complacency.

This sadly old-fashioned tradition, upheld in the recent broadcast addresses of Prof Levy, has only one other surviving representative in Great Britain. In the Soviet Union it is taken for granted. Perhaps his frequent visits to Russia in recent years have hardened Mr Crowther in the archaic conviction that science does not require a coating of saccharine mysticism to establish its cultural credentials.

Mr Crowther's latest book is in the form of an itinerary. If for this reason it is, conventionally speaking, without form, it is certainly not void. It is a mine of intimate and painstaking observation, annotated with copious statistics, embellished with a minimum of propaganda for or against the political practice of the Soviet regime. The bulk of the material is based on a visit to Moscow and Leningrad during 1931, when he accompanied the Principal of the Manchester College of Technology, Mr Mouat Jones, who was invited by the Supreme Economic Council to discuss with them problems of technical education. Technical education is an issue of vital importance to the success of the Five Year Plan, on account of the shortage of highly trained technical workers in a country which has previously lagged behind western Europe in the development of urban industry.

Perhaps the outstanding difference between the present tendency of higher education in the Soviet Union as contrasted with western institutions is specialisation. Courses of theology, anthropology, psychoanalysis, and biophysics do not appear side by side in the calendar of a single institution.

"Soviet technical colleges have been organised on the monotechnic principle. Polytechnics have been dissolved into groups of monotechmics, which probably helps to explain the extraordinary number of colleges with courses of university standard. There are monotechmics for turbine engineering, for building, for margarine manufacture, for central power station engineering, etc. Each college is run in close connexion with some factory, the students gaining shop experience in the factory, and sometimes the factory staff doing some teaching in the college. The relations between the college and the factory with which it is associated are organic and not casual."

One of the grave defects of educational progress in America and western Europe is prodigal expenditure on buildings destined to outlive the usefulness of their design. A guiding principle in the development of the monotechnic policy is the concentration of technical institutes in suitable situations, where associated industries are concentrated. Since the Soviet Union anticipates

immense changes in the localisation of industry, expenditure on buildings is kept at a minimum. The claims of adequate equipment come first.

"There is much lavish equipment. We saw at least two college laboratories better equipped than anything of the kind in Britain, these were for artificial silk technology and machine tools. The exterior of buildings is often deceptive. One may go up to an old building whose outer walls are peeling and surrounded by appalling bogs of mud, walk into the entrance hall through crazy swing doors into filthy corridors, and enter a spotless laboratory shining with distemper and light, and fitted with the latest apparatus."

In Great Britain a similar policy of development carried out under present conditions would entail a considerable restriction on the choice of available students. Doubtless this consideration has reinforced other factors tending to strengthen our own policy of founding new provincial universities with inferior equipment in mushroom-like profusion. The Soviets have met this difficulty in their own way. Technical students are paid wages by the State.

"As the student is not economically dependent on his parents he can afford to ignore their probably conservative tendencies. As his living is guaranteed he can live anywhere in Russia, at the most convenient place. In Britain we take the colleges to the student to save his parents and himself trouble and expense, in Russia the student receives a wage and is as mobile as a journeyman artisan."

The number of higher technical institutions in the Soviet Union is expanding with remarkable rapidity under the impetus of the enthusiasms which the Five Year Plan has engendered. Of the higher technical institutions with courses of university rank Mr Crowther states

"there are 188 of them in existence in U S S R, though doubtless they vary in standard and degree of development. The population of U S S R is 160,000,000, so there is approximately one technical high school to each million of the population. The various institutes and parts of institutes in the British Empire, including India, which might be considered as parallel to the U S S R technical high schools, total perhaps 240, for a population of 500,000,000, i.e., one to about every 2,000,000 of the population. The figure 240 is arrived at by counting up the number of universities and university colleges and multiplying by three to allow for the multiplication made by the subdivision of polytechnics into monotechmics in U S S R. It is almost certainly unduly favourable to the British Empire, but helps to express the proportion."

An integral part of the policy of Soviet technical education is to link the forces of productive work

with the system of instruction at every stage. Of special interest in this connexion are the *Rabfacs* and branches of the Central Institute of Labour.

"The Rabfacs, or 'workers' faculties', are a system of secondary schools for adults of 18-30 years of age. They prepare intelligent workers for admission to the technical high schools. There are 321 of them, and those we saw seemed good and filled with earnest students, some recently demobilized from the Red Army and still in their uniforms. Only the three R's are required for entry, students are expected to leave after four years with a knowledge higher than matriculation standard. These institutes are the product of the backwardness of elementary education and the nature of social organisation. The Central Institute of Labour, or CIT, gives six-month courses on manual operations. The courses have been worked out scientifically on the time-and-motion principles made familiar by Owen, Taylor, Ford, and others. The Russians have evolved their own system. They say a raw worker can become as skilled in six months by this training as he would in four years' casual work as an artisan's mate in the shops. They propose to put 700,000 workers through such courses in 1931."

It is not surprising to learn that the Russians have their own way of meeting the claim that a 'liberal' education fits the student to take an interest in the government of the country. "Besides his technical studies, the student has to do much social work. He must attend heavy courses in political science in which he learns the philosophy of communism and the ideas of Marx and Lenin."

Judging from the syllabuses of the qualifying examinations (p 55 *et seq*) for entrance to the higher technical schools—especially those in mathematics and physics—the teaching of Marx and Lenin does not exert any appreciable influence on the teaching of science at present. The requirements of materialist examiners seem to be substantially identical with those of examiners in western universities where the official philosophical point of view is idealistic. Pure mathematicians will be reassured and experimental educationists will be disappointed to learn that there is little evidence of any attempt to link the teaching of elementary mathematics with the practice of the workshop or to break away from the tradition of formalism which we ourselves have inherited from classical idealism.

According to Mr Crowther there is immense enthusiasm among the students. Their enthusiasm is instructive in its bearing upon the place of competition in a scientifically planned economy.

"Many of the students we saw were more enthusiastic than any groups of students we had seen

anywhere else in the world. Perhaps they were enthusiastic for technical education because life in Soviet Russia offers so few luxurious distractions. Interest in work is stimulated by competitions between the students of institutes. Two institutes sign an agreement to compete with each other in academical prowess. We attended an impressive ceremony for the signing of the agreement for one of these 'Socialist competitions' as they are called."

### The Study of the Soil

*Soil Conditions and Plant Growth* By Sir E John Russell (Rothamsted Monographs on Agricultural Science) Sixth edition Pp viii + 636 + 7 plates (London, New York and Toronto: Longmans, Green and Co, Ltd, 1932) 21s net

IT is difficult to realise to-day how recent is the study of the soil as an entity. The earliest contributors to what was later to develop into soil science regarded the soil almost as an inert vehicle for the supply of some active principle essential to plant growth. For van Helmont this principle was water, for Glauber saltpetre, and for Kulbel a product of the organic matter. At the end of the seventeenth century, Woodward, it is true, had shown that both soil and water are alike essential for plant growth, but that air is also a necessity was not demonstrated until the classical researches of Hales in 1731. It was not until the early part of the nineteenth century that Humphry Davy, and later Schubler, stressed the importance of the physical properties of the soil. By the middle of the nineteenth century the controversy between Unger and Thurmann, *inter alia*, as to whether the physical or chemical properties of the soil are the more important for plant life, served to stimulate further inquiry into the needs of plants.

The complexity of the physical and chemical problems involved was not, however, adumbrated until van Bemmelen demonstrated the colloidal properties of the soil, in 1878, and Way, in 1850, the phenomenon of double decomposition, leading in recent times to the researches of Knop, Gedroiz, and Hissink on exchangeable bases. In the late 'seventies, Schloesing, Muntz, and Warrington were laying the foundations of soil bacteriology, but yet it is perhaps true to say that, whilst up to the end of the nineteenth century many investigators had utilised the soil as a medium for analytical research, the synthetic concept was almost entirely lacking. With the present century came a definite recognition of the interdependence of the various soil conditions and the importance of their interaction for plant life.

The work at the Rothamsted Station by a co-ordinated team of investigators, first under Sir Daniel Hall and since 1912 under Sir John Russell, epitomises the changed method of inquiry into soil problems, and though the actual synthesis of a soil eludes us, the synthetic attitude of mind has in no small degree mitigated the evils of analytical abstraction

The successive editions of the work before us, from the slim volume of 1912 to the present robust tome of nearly four times the size, constitute a record of the development of soil science in relation to plant growth during this modern period. The last quarter of a century has not only witnessed detailed investigation of the organic population of the soil at Rothamsted, initiated as the result of Russell and Hutchinson's classical researches on partial sterilisation of the soil, but, also, the studies of plant ecologists, which emphasised the properties of natural soils and their correlations with plant successions, inevitably led to the recognition that the soil is a dynamic and not a merely static complex. Owing to the continued action of climatic and biotic factors, a soil can thus pass from an immature to a mature condition.

One of the most important additions in this volume treats of this dynamic aspect, and deals with the changes which the composition of the soil undergoes and the climatic classification of soil types. Here the inclusion of the results of Russian investigators will be the more welcome from the relative inaccessibility of some of the original publications. The two chapters dealing with the soil in Nature, of which the first is concerned with the changes in mineral composition and the second with the changes in the organic matter, replace the former chapters on the chemical and physical relationships of the soil and the carbon and nitrogen cycles. The essentials of the previous text are retained, but the new form with additional matter extends to a further thirty-two pages. The general character of the work, which remains unaltered, is too well known to require indication, whilst the smaller additions throughout are too numerous to specify. It must therefore suffice to say that the present edition has been brought thoroughly up to date, and is consequently even more indispensable than heretofore as a handbook alike for the agriculturist, the botanist, or indeed anyone interested in the problems concerned with the complex relations between plants and the medium in which they grow.

E J SALISBURY

### Short Reviews

*Engineering Geology* By Prof H Ries and Prof. Thomas L. Watson. Fourth edition. Pp vii + 708. (New York: John Wiley and Sons, Inc., London: Chapman and Hall, Ltd., 1931) 25s net.

THE appearance of a fourth edition of Ries and Watson's "Engineering Geology" is an indication of continued appreciation of a useful work which covers a good deal of ground and provides the civil engineering student, for whom it is intended, with a very fair and reasonably adequate survey of the manifold aspects of the subject. Written by professors of geology attached to two universities (Cornell and Virginia) in the United States, the basis of illustration is mainly North American and, for that reason, may be none the less attractive to the European student, as widening the range of his knowledge. The photographic views are excellently reproduced, and the diagrams generally are very clear and distinct, as also is the text. There is, however, an unfortunate omission of a decimal point in a table on page 446 *l*, and the index, though fairly full, is not helpful in tracing information—about permissible foundation pressures, for example.

In a manual of this kind, which touches on a great variety of matters germane to the subject in varying degrees, it would be easy to make carping criticisms as to omissions and inadequacies of treatment. Mining, quarrying, tunnelling, water supply, building, embankment, harbour work, and road construction are all engineering operations requiring a knowledge of geology, and 700 pages do not provide any excess of space for so extensive a purview. Probably, here and there, some fuller treatment might be felt desirable, but, on the whole, it will be admitted that it would be difficult to compile a textbook on lines to which unqualified agreement could be secured. The authors avow that their aim throughout has been to emphasise the practical application of geology to engineering work, and it is in regard to this practical side that the book will make its most effective appeal.

B C

*The Examination of Fragmental Rocks* By Prof F G Tickell. Pp x + 127 + 12 plates. (Stanford University, Calif: Stanford University Press, London: Oxford University Press, 1931) 25s net.

THE physical examination of rocks and their component minerals, with which this book deals, forms part of many technical investigations. Among the substances which may profitably be tested by methods here described are sedimentary rocks in geological studies, particularly in connexion with oil geology, building stones, sands intended for specific industrial purposes, raw materials for the ceramic industry, and soils. Prof Tickell has incorporated in his manual those methods of investigation which are likely to be of common interest and utility. The treatment presupposes a knowledge of scientific fundamentals.



The first part of the book describes methods for the size analysis of grains, and for the determination of the porosity and permeability of rocks. This is succeeded by a chapter dealing with the preparation of samples for optical examination. A knowledge of optical mineralogy is not assumed, and in Chap. v full instructions are given for the identification of minerals by their optical properties, with the aid of the petrographic microscope. The treatment here is practical rather than theoretical, being aided by explanatory plates and diagrams. The book concludes with a descriptive list of minerals commonly occurring in sedimentary rocks, a determinative table of the non-opaque minerals of the same group (unfortunately printed in such small type as to hinder rapid reference), and a bibliography. In view of the varied materials to which the practical methods elaborated may be applied, these latter three sections are not perhaps so exhaustive as might be desired. The value of the book, however, lies in its description of laboratory methods, and for this purpose it can be recommended.

*High Speed Steel* By Marcus A. Grossmann and Edgar C. Bain. Pp. ix+178. (New York: John Wiley and Sons, Inc., London: Chapman and Hall, Ltd., 1931) 17s. 6d. net.

THE practical importance of the high-speed steels in the engineering industry, coupled with their interest from the metallographic point of view, renders any account of these materials of wide appeal. English readers should perhaps be warned that, so far as the manufacture is concerned, the treatment of this applies specifically to American practice, which for many reasons would not be followed in its entirety by producers in Great Britain. It is of interest, for example, that the authors do not even mention the use of the induction furnace as a melting appliance for such alloys. Further, except for special purposes, smaller ingots would be cast here than apparently are usual in America. These smaller ingots are less subject to serious heterogeneity than larger masses would be, but of necessity result in a considerable reduction in the amount of work which can be put upon them.

The second section of the book is devoted to an account of the properties and metallographic characteristics of the alloys. A quite considerable amount of information has been concentrated into these pages, and on the whole the existing state of knowledge is fairly summarised. The position is such, however, that differences of opinion are not surprising. Most metallographers would hesitate to be quite so dogmatic as the authors on many points regarding, for example, the exact composition of the constituents which occur in these steels, or respecting the exact function of each of the elements which are present. The work is, however, of considerable interest and value, it deals with a most complex alloy system, and if, from its very nature, it emphasises the necessity for further research of a definitely fundamental type, it will perform a still more useful purpose.

F. C. T.

*Recent Advances in Microscopy Biological Applications* Edited by Dr A. Piney. Medicine, by Dr A. Piney, The Living Eye, by Basil Graves, Zoology, by Dr E. W. MacBride and H. R. Hewer, Botany, by E. C. Barton-Wright. Pp. vii+260. (London: J. and A. Churchill, 1931) 12s. 6d.

THE four chapters within the covers of this book are so diverse in their subject matter—and even more in their method—that it seems scarcely worth while to make them into a volume. The chapter on the microscopy of the living eye, though written with expert knowledge, stands apart from any field in which the others might be included. The first chapter is essentially a short account of recent advances in human histology, but is entirely undocumented. The last two chapters purport to deal respectively with animal and plant cytology. The former chapter, however, deals almost entirely with the cytoplasm. The reason given for practically omitting attention to the nucleus is that the cytologist's work in this field is "practically at a close" since the general correlation of Mendelian laws with chromosome behaviour. This view leaves out of account the recent work on nuclear structure. The chapter gives, however, a very good survey of investigations on such cytoplasmic structures as Golgi apparatus and mitochondria, which will be found very useful for reference. The last chapter is too limited in outlook to be of much value, although much of the material included is of extreme interest, if adequately presented and discussed.

*Patterns for Eight Simple Relief Models illustrating Geological Structures* Designed by Dr Frank Smithson. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., Inc., 1930) Patterns, 5s. 6d., Cards specially suitable for mounting the patterns, 3s. 6d., Models made-up, uncoloured, 45s., Models made-up, hand-coloured, 63s.

THE patterns prepared by Dr. Smithson are printed in black and white on paper of excellent quality for taking water-colour and varnish. The models they are destined to form differ from those previously issued in that they illustrate the relation between surface relief and outcrop. The structures illustrated are as follows: 1, escarpment with tilted strata; 2, hills and valley with horizontal beds; 3, beds dipping up a valley; 4 and 5, beds dipping down valleys, sloping respectively at angles more and less than the dip (these two models placed together give a valley inlier); 6 and 7, folded beds with axes running respectively across and parallel to the valleys; 8, unconformity. Full instructions for making the models, with an illustration and description of each model, are included. When made up, the models are three or four inches high on a base ranging from 6 in.  $\times$  4½ in. to 6 in.  $\times$  9 in. They may be strengthened by coating with size and varnish. The models are clear and simple, and should prove valuable as an aid to the elementary student in understanding geological maps.

### The Zoological Survey of India \*

By Lieut.-Col R B SEYMOUR SEWELL, I M S, Director, Zoological Survey of India

IN the year 1784 the Asiatic Society of Bengal or, as it was then called, the Asiatick Society, was founded by Sir William Jones. The formation of a Museum was not definitely stated to be one of the objects of the Society, but specimens were frequently sent to the Society, either for examination and report or for safe custody, and in 1796 a definite proposal for the erection of a suitable building, to house the collections that had thus accrued, was first mooted. It was, however, not until 1808 that the Society came to possess its own building, which it still occupies to-day, but from then on definite efforts were made to establish a Museum and this was finally achieved in 1814.

Although Sir William Jones, the founder, was opposed to the collection of zoological objects, on the ground that it entailed the destruction of life, there was, nevertheless, from the very inception of the Museum a quite definite biological bias. At the outset the Museum was subdivided into two parts, (a) comprising archæology, ethnology, and technical exhibits, and (b) including geology and zoology. The former section was placed under the care of the Society's librarian, and the latter under a special curator, the first to be appointed being Dr Nathaniel Wallich, who presented to the Museum duplicate specimens from his own collection in order to form a nucleus.

Up to 1836 the Museum was supported entirely from the funds of the Society, but in that year, owing to financial troubles and losses, consequent on one of the Calcutta banks closing its doors, the Society was compelled to petition the East India Company for assistance in maintaining the Museum and the necessary staff, and in 1839 the Company sanctioned a grant of Rs 300 per mensem for this purpose. The first curator to be appointed under the changed conditions was Dr J T Pearson of the Bengal Medical Service, thus commencing the close association between the Museum and the Government medical services that has continued to the present time. The continual growth of the collections in due time again caused a strain on the Society's resources, and in 1856 the Government of India was petitioned to found an Imperial Museum for India, the outbreak of the Indian Mutiny caused matters to be postponed for a few years, but in 1862 the Government announced its intention of founding such a Museum in Calcutta, and by the Indian Museum Act of 1866 definitely provided for its establishment and created a Board of Trustees for its management. The actual construction of the building naturally took some time, and it was not until 1875 that the Museum was ready for occupation, and the first two galleries, namely, those of archæology and the mammalia, were thrown open to the public in 1878.

A study of the records of the Society shows that during these early years a number of distinguished zoologists had contributed to the collections, and

among these one may perhaps mention Dr J Anderson, who had made two collecting expeditions into Yunnan and China, in 1868 and 1875, and later became the first curator of the Indian Museum. Various other collections came from regions so far apart as Abyssinia, Persia, Tibet, different parts of India, Assam, and Burma, and in addition the Society received very valuable collections that had been made during the Persian Boundary Commission (1870-72), the second Yarkand Mission (1873-74), and the Dafia Expedition (1874-75). All these collections were handed over by the Asiatic Society to the Indian Museum to form the nucleus of the zoological collections.

The next stage in the evolution of the Zoological Survey of India may be said to have begun in 1875 with the opening of the Indian Museum as a State museum, and the appointment of a permanent staff, entirely maintained by funds provided by the Government of India. During the preceding few years the Asiatic Society had been taking a very keen interest in the schemes that were being put forward in other parts of the world for the investigation of the deep-sea fauna, and it felt that India should also play its part in these investigations, the Government was at this time considering the formation of a Marine Survey of India, and in consequence of the representations made by the Society it determined to appoint to this survey a special officer, the surgeon-naturalist, whose duty it would be to carry on investigations on the Indian deep-sea fauna, at the same time ruling that the collections thus made should be the property of the Asiatic Society of Bengal and, after identification, should be incorporated in the collections of the Indian Museum. The first appointment to the post of surgeon-naturalist to the Marine Survey of India was made in 1875, and in 1881 the Royal Indian Marine Survey ship *Investigator* was launched.

At its inception the Indian Museum included sections dealing with zoology, geology, and archæology, and it was not until twelve years later, in 1887, that the section of art and economics was added. From the very commencement the importance of the zoological section was clearly recognised, and this is shown by the fact that the first three appointments to the staff were given to zoologists, namely curator of the Indian Museum, Dr J Anderson, assistant curator, Mr J Wood-Mason, and first assistant to the curator, Mr G Nevill. A few years later the surgeon-naturalist was given an unofficial status in the Museum by being appointed an honorary assistant. Thus, very soon after its inception, the Museum staff consisted of four zoologists.

With the creation of a permanent staff, and as a result of a breadth of vision and a true appreciation of the value of zoological research that has ever characterised the Trustees of the Indian Museum, it became a recognised part of the function of the

\* Paper read before the Association of British Zoologists, Jan 9, 1932

staff to go out into the field and make their own collections, so as to make a study of the living, just as much as of the preserved, animals, it was thus possible for a number of expeditions to be carried out in various parts of the Indian Empire and even beyond its frontiers, and among the latter regions that were visited, mention may be made of the expeditions by the late Dr N Annandale to the Lake of Tiberias in Palestine, to the Talé Sap in Siam, and to Lake Biwa in Japan. These activities naturally resulted in large accretions to the collections, and during this second period in the history of the Zoological Survey very considerable further additions were made by a succession of surgeon-naturalists on the RIMS *Investigator*, pre-eminent among whom stands Col A Alcock, I.M.S. During this period large additions of valuable collections of both the land and fresh-water fauna were obtained as the result of systematic collecting during certain political and military expeditions, notably during

- (1) The Afghan Delimitation Commission, 1885,
- (2) The Afghan-Baluch Boundary Commission, 1896,
- (3) The Tibet Expedition, 1903-4,
- (4) The Sistan Arbitration Commission, 1903-6, and
- (5) The Abor Expedition, 1911-12

Numerous additions were also presented to the Museum by friends of the department, such as officers of the Geological and Botanical Surveys of India, the Indian Forest Service, and the Indian Medical Service, by planters in various parts of India, and finally, but by no means the least, by the officers of the Hooghly Pilot Service, to whom the Museum owes a very valuable collection of the fauna of the estuarine region at the mouth of the Ganges. Special mention must also be made of the collections made by the officers of the Fishery Department of the Government of Bengal and by the research trawler *Golden Crown* during investigation into the fishery resources of the Bay of Bengal.

Several very valuable collections, such as the de Niceville collection of butterflies, the Dudgeon collection, etc., were also purchased by the Trustees.

The rapid increase in the size of the collections, and the consequent work of the Zoological and Anthropological Section of the Museum, resulted in a gradual increase in the staff, and in 1916 there were four zoologists on the permanent staff of the Museum, and, in addition, attached to the Museum were one unofficial, though paid, worker, the late Mr E Brunetti, and the surgeon-naturalist—the total staff thus being six.

It was in this year, 1916, that the Zoological and Anthropological Section of the Indian Museum was converted by the Government of India into the Zoological Survey of India. The reason of this conversion is not to be found in any change in the duties of the officers of the department, but in the recognition by the Government that the work of the section had been and then was, in all essential features, similar to the work that was being done by the already existing Geological and Botanical

Surveys, and the need of placing the head of the section on an equal footing with the directors of these other Surveys as a fellow-trustee of the Museum and not merely a paid servant of the Trustees.

The ever-increasing work of the Survey has from time to time necessitated the creation of additional appointments, and at the present day the full staff as sanctioned by the Secretary of State should consist of a director, two superintendents, and seven assistant-superintendents, the last addition to the staff being the naturalist to the Marine Survey, a post that was previously always held by an officer of the Indian Medical Service. Up to the present time, however, only seven officers have been appointed, and of these one is an anthropologist. In consequence of the policy of the Government of India to indianise the various services, as many Indians as possible have been selected to fill the various posts as they fell vacant or were sanctioned, and to-day the director is the only European in the Survey, the other six officers being Indian.

The conversion of the Zoological Section of the Museum to a Survey gave official recognition to the view that field-work was one of the most important duties of the department, and it thus became possible to formulate definite programmes of work that could be spread over a series of years. A commencement on definite survey lines had, however, been begun some years previously by investigations into the lake fauna of Asia, and this had culminated in the survey of the Chilka Lake, a special volume of the *Memoirs of the Indian Museum* being devoted to the results. The first definite survey of the newly created Zoological Survey was undertaken at the request of the medical authorities in India, who, as the War of 1914-18 drew to its close, became anxious lest the disease schistosomiasis, that was unknown in human beings in India, though present in other animals, might be introduced by troops returning from areas overseas in which this disease is rampant. Systematic investigations were, therefore, undertaken in order to discover whether any of the known mollusc hosts of the Schistosome might be present in India, or, alternatively, whether any of the more common fresh-water molluscs could act as such a host, and, in addition, to determine what species of Cercariæ were already living in the country. As a result of these inquiries, the Zoological Survey was able to inform the Government that, so far as it was possible to judge, there was no fear of an extension of this disease into India, a conclusion that was entirely justified by results, for although the troops from overseas were brought back to India without any precautions whatsoever being taken in the way of quarantine, there has been no spread of this disease in that country.

Our knowledge of the fauna of India is still very incomplete, and in every case in which an officer of the Zoological Survey of India has taken up the study of a group in the animal kingdom it has proved to be necessary that he should first pay careful attention to the taxonomic side, in order

to determine the various species that are present. As a result, considerable progress has been made on these lines, and during the sixteen years that the Survey has been in existence the number of new species that have been described and of 'types' that have been added to the collections of the Indian Museum has averaged some one hundred and twenty-five a year. Up to quite recent times the Survey has not attempted to deal with purely economic problems, unless specially requested to do so, it was rightly considered to be of more importance that their energies should be devoted to purely scientific research, for no zoological research can have any economic value unless it has a scientific basis, and the foundation of all such work is taxonomy. Nevertheless, the Survey has from time to time contributed towards the elucidation of problems of economic importance, and has been consulted by various local governments on such problems as the reorganisation of fishery departments, the institution of biological stations, the preservation of the fauna—as, for example, the Monitor lizards that were being exterminated for the supply of skins for the leather market—oyster fisheries, or the control of various species of animals that were directly or indirectly destroying crops. Within the last two years the Survey has by circumstances been compelled to take up one problem of economic importance, namely, the maintenance and preservation of the *Trochus* and *Turbo* fisheries in the Andaman Islands.

For many years past, each officer has been encouraged to take up two lines of study—one taxonomic and the other general, they are thus brought into touch with some of the wider problems of zoology and are in a better position to take advantage of their opportunities for study in the field, while the department as a whole is in a sound position to undertake team-work and thus to tackle the investigation of any of the more general problems, on the solution of which so much may depend in a country like India, in which agriculture and public health are the two subjects of greatest importance.

The Zoological Survey of India publishes the results of its research work in two serials that are devoted to zoology, namely, the *Records* and *Memoirs of the Indian Museum*, and within the

last year has commenced a third, entitled *Anthropological Bulletins from the Laboratory of the Zoological Survey of India*. These publications are very largely composed of original papers by the officers of the Survey, and by a system of exchanges with some three hundred other societies and institutions the Survey is able with comparatively little cost to maintain a very fairly complete and up-to-date library, that without any doubt is the finest zoological library for purposes of research in Asia. This library is at the service of every *bona fide* zoologist throughout the whole of India, a list is kept of all those who are engaged in research work, and every such worker is allowed to have from the library two volumes at a time for a period of a fortnight. In this way workers are able to keep in touch with and consult recent literature, without which it would be impossible for them to carry on their researches. Within the limits imposed on it by space, the Zoological Survey of India also provides accommodation for any research worker who wishes to come to the Museum in order to carry on his work either in the library or in the laboratory, and there is an ever-increasing demand for facilities of this nature, not only from zoologists in India but also from other countries.

It is no exaggeration to say that if the Zoological Survey is in the future to be curtailed, either in its personnel or its financial resources, to such an extent that the continuance of its publications is rendered impossible, such a blow will be dealt to the study of zoology in the whole of India that it will put the country back to where it was in 1875, when the Museum was first started, and will render almost impossible the satisfactory or trustworthy investigation of every problem in which zoology may be concerned. Finally, any drastic reduction of the staff must seriously endanger the collections. Such collections, especially in a tropical climate, require constant attention for their preservation and continuous study and research to maintain them in an up-to-date and scientific condition, so that each animal is correctly labelled and can at once be referred to for comparison and examination, and if in the future these collections are allowed to decay, the loss, not to India alone but to the whole world, will be one of the first magnitude.

### Steel in Building Construction

IT is usual to criticise methods of engineering design by calling the engineer's 'factor of safety' a factor of ignorance. In one sense the accusation is true, since the factor is a cover for uncertainties, but, in effect, it is a concise expression of experience and, properly used, is as legitimate as the apparently more rigorous processes in calculation. It is an inheritance. The efforts of progressive engineers are bent towards its improvement. They attempt the reduction of its margins by enlargement of data, perfection of analysis, and advancement of materials. Sometimes a greater precision in things understood leads to a reduction of the factor, only to disclose

the increased importance of things less well understood, and thereby to compel a return. The subject of fatigue in materials and the history of the development of high speed machinery provide numerous examples.

It can scarcely be denied, however, that the factor of safety is subject to serious misuse at times. Weak design methods are frequently characterised by a meticulous arithmetical accuracy in inadequate calculation, covered by an arbitrary factor that may make the design quite safe but certainly renders the careful arithmetic ludicrous. Possibly this charge of imperfect calculation and arbitrary safety factors could be

laid against building structure design. At least, building codes vary so widely that there would appear to be justification for the belief that they reflect a very variable standard in the comprehension of data and of method.

The confusion created by varying codes, in conjunction with a feeling that the full value is not being derived from the use of steel in building structures, and that the highly advanced technique of modern steel structural work is not being fully exploited, has led to a general recognition that comprehensive and systematic investigation is required to obtain precise information and thereby facilitate the establishment of economical design and more uniform regulations. While the recognition of the necessity is widespread, it is gratifying to find that the Department of Scientific and Industrial Research in Great Britain has taken first and bold steps towards this end. The first report, now issued, by the Steel Structures Research Committee,\* set up by the Department in 1929, shows that a wide view has been taken of the task, and that an ambitious programme of research has been undertaken.

The Committee was appointed to review present methods and regulations for the design of steel structures, and to investigate the application of modern theory to such design with a view towards its improvement by the establishment and definition of the data and processes required. The remit would have been more concise and equally comprehensive if it had called for an investigation of all aspects of the 'factor of safety' in steel building structures. The connexion of theory and practice is essentially implied in 'factor of safety'. The factor of safety may be nominally modified by extended theory without compelling any important alteration in practice. Theory may advance in completeness, but practice can only be modified by research.

The Committee has very completely realised the true interrelations of established practice, advanced theory, and experimental research, and the programme of work reflects this clearly. But, while understanding the necessity of conducting a full survey of existing methods as a guide to research developments, it has been assumed that the nature of the essential problems would not be greatly altered by the examination of a multiplicity of design systems, while research progress would certainly be impeded. The division of the main lines of work is therefore of the order of an 'intelligent anticipation' of the requirements, and the Committee has decided upon schemes that embrace such leading items as floor loads, building strains, stress analysis, materials, welded connexions, and building vibration. Good progress appears to have been made with all of these except the last, which, under modern conditions, may ultimately present a restrictive influence on the easy development of more economical design.

The enormous amount of detail work described in the report forbids even a summarised mention

within this space, but the interest of technical structural engineers will be aroused by the design and tests of the new 'micrometer-microscope' strain gauge and the proposed use of such gauges on the five-story framing of the new Geological Museum at South Kensington, to obtain results for the unloaded frame and as the floors are progressively loaded. There are also most interesting test results on the buckling of I-beam webs, following a request by the British Steelwork Association to have the question of web stiffness examined. In a section on materials, Prof. A. Robertson presents the results of an investigation on the use of small turned specimens in steel testing. These display distinct differences when compared with the yield point results for large flat specimens.

Structural steel framing is of an apparently simple rectangular form, but requires an elaborate theoretical development for its stress analysis. The theory is usually based on the assumption that the joints are rigid. This is not actually the case. The report deals with the general theoretical case of non-rigid connexions briefly, but it is clear that all questions of slip and flexibility at joints require extensive experimental work, as well as theoretical investigation. Both theory and experiment have been employed for riveted, bolted, and welded connexions by Prof. C. Batho, whose results and views are given in a lengthy section of the report.

Laboratory tests on joints alone, however, can scarcely promise to give conclusive information. In actual framing, the mysteries of eccentric loading accompany those of joint flexibility. Calculations given in the report with different assumptions as to eccentricity and joint rigidity show remarkable differences. This appears to have prompted the design of a full scale, three-story, experimental frame which has been erected at the Building Research Station and is to be subjected to extensive experiment when loaded by water tanks. This is perhaps the most notable of the Committee's efforts, and represents an exceptional step in structural research.

A full scale experimental research is always impressive but is, unfortunately, seldom comprehensive. The natural desire is, therefore, to extract the most from the expensive large-size equipment and to endeavour to generalise by the aid of model investigations. The recent American research on arch dams is an excellent example of this procedure. The Committee has also model work in hand, which includes the Beggs deformeter method with celluloid models, and slope measurement methods with others. It is to be hoped that the joint conditions in rectangular framing will not prove too much for small scale models.

The last section of the publication is preceded by the report of the panel dealing with the welding of steel structures, which describes tests of welded joints and outlines a future programme of research upon this mode of construction. Welded connexions are not yet widely adopted and a great deal of investigation will probably be necessary before they become generally acceptable, but

\* Department of Scientific and Industrial Research. First Report of the Steel Structures Research Committee. Pp. xii + 276 + 11 plates. (London: H.M. Stationery Office, 1931.) 5s. net.

they offer many advantages, and more precise knowledge and methods of control may overcome the hesitancy of responsible authorities

The first and last sections of the report are widely apart in position and closely related in theme. The first—which includes in one place an account of a most interesting survey of the real loads on office floors—presents the results of a comparative examination of the regulations controlling steel frame building construction in Great Britain, the Dominions, and in some foreign countries. The general comparison of regulations displays extraordinary variations in such matters as floor loads and wind pressure allowances, and in the clauses governing the proportioning of members. On practically every page of this section there is evidence of the confusion and variety

that can be introduced by autocratic authorities at work independently

The last part presents the recommendations of the Committee for a code of practice governing the general use of structural steel. In view of the fact that these recommendations accompany a first progress report, there is always the probability of future amendment in the light of subsequent data. It is understood, however, that the code will be explicitly referred to in the model by-laws to be issued by the Ministry of Health. This may be taken as an augury of the full recognition that will be accorded the completed work of so influential and representative a Committee, the first report of which displays a breadth of vision and power of planning that promises ultimate success in a difficult task.

### Obituary

PROF P N KRYLOFF

THE name of Porfiri Nikitich Kryloff, professor of botany and plant geography at the University of Tomsk, who died on Dec. 27, 1931, at the age of eighty-one years, will always be associated with the exploration of the Siberian flora. Born of a poor family, Kryloff had to earn his living ever since he left his school, still a boy in his teens. Becoming an apprentice in a chemist's shop at Perm, young Kryloff became seriously interested in chemistry and medicinal plants, and devoted his spare time to studying for an examination to obtain a pharmacist's degree at the University of Kazan, and to the collection of plants. After obtaining the degree, he continued to work as a dispensing chemist.

The botanical exploration of the Perm province and of the Ural Mountains was now Kryloff's main and only recreation. With very limited resources, often on foot, he wandered over that enormous area, and produced a series of papers on its flora, which was then very little known. In 1874 it became possible for Kryloff to abandon his old profession and to devote himself entirely to botany, by taking a modest appointment as a 'learned gardener' at the University of Kazan. While at Kazan, he made an extensive study of the flora of that province, but dreamed of botanical explorations in wider and less-known regions.

At the foundation of the new University of Tomsk, the first scientific centre in Siberia, Kryloff did not hesitate to take there the same post of 'learned gardener', becoming later the keeper of the botanical museum, which he built up himself. A new, and practically virgin, field was now open before Kryloff, and he threw himself into this congenial task with his usual energy. Most of western Siberia, the Altai Mountains, and northern Mongolia offered an inexhaustible supply of most interesting problems in the systematics and distribution of plants. An enormous herbarium, comprising more than 200,000 specimens of plants, was the result of the journeys of Kryloff himself and of his students, who were attracted by his

unaffected and enthusiastic love of Nature. In systematic studies in the herbarium Kryloff was as thorough as in collecting. He prepared detailed descriptions of all the species known to occur in the regions visited, and maps showing areas of their distribution elsewhere. This formed the basis of his well-known 'Flora of Altai and of the Tomsk Province', published in seven volumes between 1901 and 1914. The importance of this work for the study of the flora of temperate Asia and even of Europe cannot be overestimated, and it is not surprising that it was soon out of print.

In 1913 Kryloff was invited to take the post of botanist in charge of the Siberian herbarium at the Academy of Sciences in St. Petersburg but the economic difficulties of living in the capital during the revolution induced him to return in 1917 to Tomsk, where he became professor of botany. Here he set himself a new and a very ambitious task of preparing a complete flora of western Siberia, from the Urals to the Yenisei and from the Arctic Ocean to central Asia. It may seem almost unbelievable, but the work was completed, with the usual masterfulness, within six years, after which several years were spent in endless efforts to find the funds for its publication. It was only in 1926 that the great 'Flora of Western Siberia' began to come out in parts, and is still continuing to be published.

Prof. Kryloff's interests were not purely floristic, but mainly phytogeographical, and his exceptional first-hand knowledge of Siberia and its plants enabled him to produce a series of most valuable papers on the distribution and past history of the Siberian flora. One of the points particularly well brought out by Kryloff's work was the existence in the Altai Mountains of an ancient centre of the origin of many typical Siberian plants, which later migrated widely and reached European countries. The foundation of a large and very prolific school of Siberian botanists should be considered amongst the most important achievements of this self-made pioneer of botanical exploration of Siberia.



## MR J J JOICEY

MR JAMES JOHN JOICEY, who died early in March, aged sixty-one years, was the founder of the Hill Museum and also a munificent benefactor of the Natural History Museum, South Kensington.

Mr Joicey started to form a collection of British butterflies and moths at quite an early age, but it was not until his interest in exotics was aroused that there appeared much likelihood of his adding appreciably to the sum of human knowledge. In 1910 he acquired the collection formed by Henley Grose-Smith, an ardent disciple of W C Hewitson, and two years later added to it the Herbert Druce collection. These two collections, both rich in type material from all parts of the world, were so extensive that extra accommodation had to be built to house them. The Hill Museum was thus established in 1913. Through the exertions of collectors employed by Mr Joicey from this time onwards, remarkable collections were sent home to him from Peru, the Amazon valley, Dutch New Guinea, Waigeu, the Schouten Islands, many other of the less-known islands of the Dutch East Indies, Yunnan, Hainan, and Central Africa. All these were rich in new material, or shed light upon the geographical distribution of the Lepidoptera.

The scientific results were published from time to time in various journals, but mainly, from 1921 onwards, in the *Bulletin of the Hill Museum*, which, during its eleven years' existence, has run to four handsome and richly illustrated volumes, to which, no doubt, would have been added many others had not Mr Joicey's enthusiasm for his subject outrun his ability to meet the expenses. Between 1914 and 1930 about sixty papers by Mr Joicey, in collaboration with others, were listed in the titles in the "Zoological Record."

Besides employing collectors, Mr Joicey acquired by purchase many valuable collections, notably those of Roland Trimen, H J Elwes, Col Swinhoe, Hamilton Druce, Wichgraf, Ruffarth, and others, all rich in types. A catalogue of the type specimens of Rhopalocera in the Hill Museum had just been completed, and all arrangements made for its publication, a few days before Mr Joicey's death. This, better than anything else, will indicate the value of the contents of the Hill Museum, at least from a taxonomic point of view, the total number of type specimens enumerated is 2724. In the moths, the types were probably even more numerous relatively, as they had been worked fairly thoroughly by many specialists, but as they have not been catalogued, it is not possible to give definite information. Two years ago it was estimated that Mr Joicey's museum contained approximately four hundred thousand specimens, including about five thousand types, but for some years prior to that, large sections of it, with which it was found impossible to cope at Witley, had been presented to the British Museum (Natural History) from time to time with results highly beneficial to the remaining collection, in that the staff under Mr Talbot's capable direction was able to maintain it in really excellent order and thoroughly up to date throughout.

The closing of the Hill Museum and the disbanding of its staff are events which will have serious repercussions throughout the ranks of lepidopterists in all parts of the world, and will definitely slow up the rate of advance in this much favoured though, we fear, often despised branch of science.

In addition to his intense keenness on butterflies and moths, Mr Joicey had a wide general interest in natural history, was an excellent game shot, an enthusiastic fisherman, and a very successful amateur gardener. His collection of orchids contained many rarities and had brought him quite a number of prizes.

## SIR WILLIAM SMITH

SIR WILLIAM ROBERT SMITH, who died suddenly on March 17, aged eighty-two years, commenced his career at the age of fifteen years as assistant to a chemist, but so well did he use his opportunities that he was able to enter the medical school of St Bartholomew's Hospital and later to complete his medical studies at Edinburgh, where he obtained the double qualification of the Colleges in 1871. He afterwards graduated M D at Aberdeen and D Sc in public health at Edinburgh, and became a barrister-at-law. He was keenly interested in politics—contesting some of the Scottish university seats—and in academic and civic life.

It was in the domain of public health that William Smith made his mark. He was for several years medical officer to the old School Board for London and director of the public health laboratories in King's College, London. He afterwards became professor of forensic medicine in King's College and Hospital Medical School, succeeding the late Sir David Ferrier in this office, and found time to edit the seventh edition of Guy and Ferrier's standard textbook of forensic medicine. He was a member for many years, and vice-chairman 1910-13, of the old Metropolitan Asylums Board.

William Smith will be remembered for his insistence that a special diploma in public health should be a necessary qualification for the medical officer of health of the larger districts, and the institution of the diploma in public health was largely owing to his efforts. For many years he had been principal of the Royal Institute of Public Health, of which he was the virtual founder, and only recently had completed a scheme for the removal of the Institute to a new site in Queen's Square, and had just lived to see the erection of the skeleton of the new building there. He was a good speaker and able controversialist, and the congresses of the Royal Institute of Public Health at home and abroad owed much of their success to his great capacity as an organiser. R T H

WE regret to announce the death, at the age of eighty-four years, on March 25, of Prof Rushton Parker, professor of surgery in University College and the University of Liverpool since 1882. Prof Parker practised and taught surgery since 1869, and was among the first to practise Lister's system of antiseptic surgery. For many years he was consulting surgeon to the Liverpool Royal Infirmary and Bootle General Hospital.

## News and Views

## Centenary of James Wimshurst

AMONG the best-known inventors of electrical machines of the last part of the nineteenth century was James Wimshurst, the centenary of whose birth occurs on April 13. The son of Henry Wimshurst (1804–84), the constructor of the pioneer screw-propelled ship *Archimedes*, Wimshurst was born at Poplar, and after leaving school was apprenticed at the Thames Iron Works, Blackwall, then a well-known shipbuilding yard. At the age of twenty-one years he became a ship surveyor to Lloyd's Register, from 1865 until 1874 was chief of the Liverpool Underwriters' Registry, and then for twenty-five years, 1874–99, was chief shipwright surveyor to the Board of Trade in London. Living at Clapham, he had a good private workshop and for twenty years devoted himself to the improvement and construction of electrical influence machines. The early machines of this type had all sprung from Volta's electrophorus and had been built by Lichtenberg, Bennet, Cavallo, Nicholson, and others, but it was not until the work of Topley (1836–1912) and Holtz and Wimshurst that there was any marked advance in design. The machine with radial strips of tinfoil and contact brushes was described by Holtz in 1881 and again in 1882 and 1883 by Wimshurst, whose improvements were made independently. Altogether he made more than ninety Wimshurst machines. Many of these were presented to hospitals, and two of his very large ones are preserved in the Science Museum. A member of the Physical and Röntgen Societies, and a manager of the Royal Institution, Wimshurst was elected a fellow of the Royal Society in 1898. He died suddenly on Jan. 3, 1903.

## The Asiatic Society of Bengal

THE Asiatic Society of Bengal held its 148th annual meeting in its rooms at No. 1 Park Street, Calcutta, on Feb. 1—one of its patrons, Sir Stanley Jackson, the Governor of Bengal, being in the chair. In the unavoidable absence of the president, Lieut.-Colonel R. B. Seymour Sewell, the presidential address was delivered by the senior vice-president, Dr. U. N. Brahmachari. In the address, attention was directed to the proposals put forward by the Government of India for extensive retrenchment in the various scientific services in India, many of which owe their inception to the Society, and in the Indian Museum, in which the Society takes particular interest, since the nucleus around which the Museum has been built up consisted of the Society's own collections that were handed over for safe custody to the Government in 1875. By the terms of the Indian Museum Act of 1910 these collections and all additions thereto, except those purchased afterwards by the trustees of the Museum, must, if the trust ever be terminated, be returned to the Society. It was emphasised that the maintenance of the scientific services is essential for the economic development of India, and that, whereas scientific research is one of the most profitable in-

vestments that a government can make, a country that neglects the scientific investigation of its natural resources pays, in the long run, very heavily for its neglect.

THE membership of the Asiatic Society of Bengal shows a decrease during the past three years, largely consequent on the present unsettled state of India. Among the losses that the Society has suffered during the last year by death, we notice the names of three fellows, among them the great scholar Maha Mahopadhyaya Dr. Haraprasad Shastri, who was elected to a fellowship in 1910, and five members, one of whom, Mr. James Peddie, met his death by assassination at the hands of the revolutionary party in Bengal. The fall of membership, combined with the present financial depression, has caused the Society anxiety regarding the continuance in the future of its activities, and has emphasised the need of creating and building up reserve funds for such objects as the rebuilding of the Society's premises, their present house having been built in 1808 on land granted to them by the Government in 1804, and for the endowment of the Library, which, by its continual expansion, of necessity imposes a steadily increasing strain on the Society's resources. It is a matter of some surprise to learn that in all the 148 years of its existence, and in view of all that the Society has in the past done for India, no financial benefaction of importance has ever been given to it—a state of affairs that reflects very unfavourably on India when contrasted with the support given to similar societies in other civilised (and especially western or American) countries.

## Meteorology in India

A PESSIMISTIC note is sounded in the opening passages of Dr. C. W. B. Normand's recently issued "Report on the Administration of the Meteorological Department of the Government of India in 1930–31." This report, which is dated Sept. 11, 1931, has to record a set-back in the rapid expansion of the Indian meteorological service outlined in the corresponding report of last year. The expansion was due to the legitimate demands of aviation, the set-back to the equally legitimate demands of financial stringency arising from the world's economic blizzard. Dr. Normand states that the schemes connected with aviation had in the year under review reached a stage of completion, but many schemes, some not connected with aviation, have had to be shelved. One scheme that is apparently to proceed unchecked is connected with the development of a special branch of the department to deal with the problems of agricultural meteorology. This practically originated in the Report of the Royal Commission on Agriculture in 1928. It contemplates both statistical and experimental studies, the standardisation of the meteorological and physical data collected at experimental farms, the development and standardisation of methods of measuring radiation, evaporation, soil temperature, and so on,

and the determination of the local weather and climate appropriate to each crop. It is proposed to employ two agricultural meteorologists and subordinate staff for a preliminary period of five years, at an annual cost of Rs 40,000. The necessary grant has been made by the Imperial Council of Agricultural Research.

#### The Musk Rat in Europe

Two exhibition cases have recently been placed in the Central Hall at the Natural History Museum, South Kensington, immediately facing the visitor on entering the building, in order to inform the public what kind of animal the musk rat, *Ondatra zibethica*, Linn., is, how it lives, and the damage it does. Better known as musquash, the musk rat has been for many years of considerable commercial value because of its fur, which is very beautiful, being thick, soft, richly coloured, and glossy. Naturally an inhabitant of North America, it has been imported to Europe by misguided people who thought some advantage and profit might result from this step. The experiment provides yet another illustration of the serious danger involved in interference with the balance of Nature. In its original home, the musk rat's increase is controlled by the usual kind of checks, which do not exist or have not developed elsewhere. It is said that in 1905 two males and five females were turned loose in Bohemia, twenty-one years later, in 1926, there were computed to be no fewer than a hundred millions of these animals in Central Europe. Owing to their burrowing habits, the damage that they do to waterways is enormous, and great expense has to be incurred in checking them. In Great Britain the danger has been recognised, and under the Destructive Imported Animals Act, 1932, regulations, which come into force on May 1, have been formulated to control the distribution of the musk rat in this country.

#### Destruction of Rats

IN addition to the British Museum pamphlet on rats, noticed in NATURE for Dec 19, 1931, p 1036, two others have recently appeared. All deal with the specific characters and the natural history of the black and the brown rat, and with the methods of destroying rats or preventing their ingress, so that there is a considerable amount of overlapping, but each pamphlet has its own particular points of excellence. The Ministry of Agriculture and Fisheries *Bulletin*, No 30 (price 6d net), repeats in new and much more attractive form the old *Miscellaneous Publication* on rats, and its object is to supply practical information leading to rat-destruction. The second pamphlet, by Colin Matheson, deals with "The Brown and the Black Rat in Wales" (National Museum of Wales, price 6d net), and discusses some very interesting facts bearing upon the occurrence of rats and the rat menace in the Principality. It is surprising to learn that in the years 1922-28 inclusive the rat-catcher in the Port Sanitary Area of Cardiff destroyed of black rats, by far the more rare of the two species in Britain at the present day,

22,036 from ships and 3072 from dock warehouses, and of the brown rat, only 50 and 266 in these areas respectively. But the proportions change as the docks recede, for in Cardiff City, from March 1928 until February 1930, only 78 black rats were caught, as against 1961 brown rats. The menace of such great numbers of the plague-distributing black rat in the Port area is one which the author does well to emphasise.

#### Implements from the Oldoway Beds

FOUR original implements and casts of eleven others from the Oldoway beds in Tanganyika have been presented to the British Museum by Dr L S B Leakey on behalf of the East African Archaeological Expedition, and are to be exhibited without delay at the top of the main staircase in the prehistoric section of the Department of British and Mediæval Antiquities. They come from the following beds, beginning at the base. Bed No 1, associated with *Dainotherium*, a predecessor of the elephant and generally assigned to the Miocene pre-Chelles types. Bed No 2, lower part, with *Hipparion* and *Elephas antiquus* early Chelles types. Bed No 2, upper part, the horizon of Prof Reck's Oldoway man, with *Hipparion*, *Elephas antiquus*, and *Hippopotamus gorgops* late Chelles types. Bed No 3, with fauna as Bed No 2 transition Chelles to St Acheul. Bed No 4, lower part, with *Elephas antiquus*, *Hipparion*, *Hippopotamus gorgops*, *Pelorovis* and extinct antelopes early St Acheul types. Bed No 4, upper part, with same fauna as lower advanced St Acheul types.

#### Japanese Plants in the Netherlands

THE Leyden Branch of the Royal Horticultural Society of the Netherlands, in order to commemorate the founding of the well-known acclimatisation garden for Japanese plants by Dr P F von Siebold, is planning to hold an exhibition, on May 4-8, at Leyden, of living Japanese plants, shrubs, and trees, many of which are descendants of plants imported by von Siebold. Belgian and Dutch horticulturists are collaborating to make this collection as complete as possible. At various other institutes of the University of Leyden, smaller exhibits will be held of the ethnographical, zoological, and botanical material gathered by von Siebold. Biographical materials will be shown in the University Print Collection. In the University gardens, which still contain more than forty of von Siebold's trees and shrubs, a bronze statue, by the sculptor, O Wenckebach, will be unveiled by the grandson of von Siebold and by the grandson of his head-gardener.

#### Von Siebold and the "Flora Japonica"

PHILIPP FRANZ VON SIEBOLD was born at Wurzburg on Feb 17, 1796. He studied at his home university, where he received his doctorate in medicine in 1820. In 1823 he arrived at Decima, Japan, as a military doctor, but he also devoted himself to the natural history, medicine, ethnology, ethnography, and history of Japan. At Nagasaki he founded a medical school and clinic, but for political reasons some of his ever-increasing botanical, zoological,

mineralogical, and geological collections were confiscated by the Japanese authorities in 1828, fortunately, not long before he had sent many specimens to Leyden. He also sent a living tea plant to Java, thus originating tea culture on that island. In 1827, Siebold published a small catalogue of Japanese economic plants. On Dec 30, 1829, political unrest was so acute that he was ordered to leave Japan, and he then settled in Holland. He met the German singer, J. J. Hoffmann, who was also a linguist. In 1845, Hoffmann published a description of Siebold's books, manuscripts, and maps which he had brought from Japan. Zuccarini, the Munich botanist, helped with the classification of botanical material. Publication of the "Flora Japonica" was begun in 1835 and continued until 1842, but after Zuccarini's death, von Siebold discontinued further publication and the materials became the property of the Government Herbarium at Leyden, where the Von Siebold Collection is still visited and consulted by botanists. Von Siebold's influence on horticulture was even greater. His imported specimens formed a nucleus for horticulture in Belgium and Holland, but the original "Jardin d'Acclimatisation Nippon" no longer exists. His zoological collections are preserved in the Museum of Natural History at Leyden and his ethnographical material at the Leyden Ethnographical Museum. Von Siebold died at Munich on Oct 18, 1866.

#### Decline of Australian Parrakeets

THE re-discovery of a species supposed to have become extinct is especially a matter of congratulation when it has some particular claim to interest, as is the case with the splendid grass-parrakeet (*Neophema splendida*), of which a pair has recently reached England as a present to H.M. The King. Mr D. Seth-Smith, in commenting on this in the *Avicultural Magazine* for January (p. 36), mentions that a few captured specimens had appeared in Adelaide, and that, always rare, the species, which is found in south and south-western Australia, had completely disappeared for about sixty years, and was supposed to be extinct, until a specimen occurred at Koonibba, crippled by collision with a wire fence. The special interest of the species lies in the very brilliant colouring of the male, which has a blue face and wing-patches, a scarlet breast, and yellow abdomen, contrasting with the green of the upper surface, the female has no red and is generally duller. The length is about eight inches. A whole group of small grass-seed-eating Australian parrakeets like this appears to be on the decline, common species like the turquoise (*N. pulchella*) suffering as well as this rare one. Fortunately, like so many Australian birds, they are free breeders in captivity, and may possibly be preserved if domesticated as the budgerigar has been.

#### False Mimicry in Animals

THE short-tailed South American monkeys known as uakaris are never common in captivity, so it is as well to direct attention to the recent acquisition of a specimen of the red uakari (*Cacajao rubicundus*) by the Zoological Society of London, which exhibits it in

the Tropical House along with some more familiar American monkeys. The resemblance of this species to an orang-utan in miniature is noticeable, and is paralleled in the Bird House next door by a specimen of the South American magpie tanager (*Cissopis leveriana*), which exhibits an equally striking resemblance in miniature to the magpie. Other more striking examples could be given, in both mammals and birds, of this false mimicry, or resemblance between creatures which do not inhabit the same region, when size as well as general appearance correspond. In the Bird House may also be seen an example of Chaulet's Cissa (*Cissa hypoleuca Chauleti*), which will be interesting to watch, as, like the better-known Indian species (*C. sinensis*), this green bird changes into blue without a moult, the change taking place by a gradual alteration of tint, which reminds one of the fading into blue of green paint.

#### A Direct Reading Optical Micrometer

A MICROSCOPE for measuring small lengths has recently been put on the market by Messrs W. Ottway and Co., Ltd., Orion Works, Ealing, W.5. The microscope, which gives a magnification of 25, is about 6.5 cm. long and is mounted on a small tripod. Focusing is effected by sliding the microscope tube through the holder, fine adjustment being made by rotating a milled ring on the stand. Measurements are obtained by a direct reading of a scale on a graticule fitted into the microscope, a screw focusing adjustment being provided to bring the graticule into the focal plane of the eyepiece. Scales reading to 0.01 mm. or 0.001 mm. are supplied and are easily interchangeable. The instrument can conveniently be used as a linen counter, or for the measurement of Brinell impressions or of small objects up to 0.1 mm. in length. For measurements of length up to 10 mm. an alternative objective, fitted with a 0.1 mm. scale and giving a magnification of 15, is obtainable. As the graticules may be ruled to any desired scale or pattern, the micrometer should prove useful as a test instrument in many industrial operations. It can easily be applied, for example, to the testing of screw threads, a graticule with the required thread form being used. Its compactness and the ease and speed with which readings may be made are additional advantages.

#### Performance of Gears

IN a paper by Messrs Hyde, Tomlinson, and Allan, of the National Physical Laboratory, read before the Institution of Automobile Engineers on April 4, an interesting account was given of researches which have been in progress at the Laboratory during the past few years on the performance of gears. The best gears are made of special alloy steels, either air or oil hardened, and afterwards finished to an accuracy of a few ten-thousandths of an inch by grinding. The work of the Laboratory shows that such gears can transmit power with the very high efficiency of more than 99 per cent. At the high speeds of rotation to which gears are subjected, a tooth out of its true position by less than a thousandth of an inch may come into mesh with a shock sufficient to double or

treble the normal pressure on the tooth. Although it has ample strength to withstand this augmented pressure as a steady load, if the effect is repeated often enough the metal becomes fatigued, and the tooth may ultimately break off as a result of this fatigue. Thus the fatigue strength should be the criterion employed in design, rather than the more usual considerations of static strength and durability. The experiments further showed that this type of gear can be run under load for many millions of revolutions with scarcely any appreciable wear of the tooth faces, presupposing the best conditions of lubrication. It appears as though the lubricating oil, when functioning efficiently, almost completely holds the steel surfaces apart by a highly tenacious film. Another feature of interest is that even ideally perfect gears must lose some of their running perfection when it is necessary for them to transmit power under heavy loads. This is due to the small elastic bending of the teeth caused by the heavy load, which has the effect of disturbing the perfect uniformity of the motion which the gear would otherwise transmit.

#### Earthing Radio Sets

IN the wiring rules issued by the Institution of Electrical Engineers, it is recommended that every radio-receiving set actuated by electric power taken from the public supply mains should be effectively earthed at certain specified points. The obvious way of doing this is to connect these points by conductors with a water pipe. According to the *Wireless World* for March 23, the Metropolitan Water Board has been investigating to find out whether the leakage currents flowing into their mains are producing appreciable corrosion in the mains or are eating them away at the places where the currents leave them to enter the earth. In the early days of tramway electric traction, where the current when it left the motors was supposed to get back to the generators by the tram rails, it was found that a large proportion of the current left the rails and came back by the earth, the water and gas pipes, and other conductors. In several cases damage was done to the pipes. To obviate this trouble, the Board of Trade insisted that the voltage drop between any two points on the rails should not exceed seven volts, and this has proved satisfactory. If it is found that the leakage currents are damaging the water or gas pipes, we have no doubt that some remedy will soon be invented, as electrical engineers have been making an intensive study of the problem of 'earthing' for several years. It would be very difficult to prove that the damage, if any, is being done by the mains-driven radio sets, as the currents in the earth are well known to be mainly due to cosmical and atmospheric action and to the leakage or 'vagabond' currents from electric supply stations.

#### Large Alternators

It is gratifying to find from the *Metropolitan Vickers Gazette* for January that, despite depression in many industrial centres, rapid progress was made during last year in engineering development.

Two turbo-alternators have been supplied to the power station at Clarence Dock, Liverpool, each of which has a power of 71,500 kilovolt-amperes, runs at 1500 revolutions per minute, and generates at 7250 volts. One of the two large 80,000 kilovolt-ampere machines for the new Battersea Power Station of the London Power Company is now practically completed. This is the largest 1500 r.p.m. machine yet built in Great Britain. The company has also built a 40,000 kva alternator for the Victoria Falls Power Company, two of 31,250 kva capacity for Japan, and several for Australia, Mexico, and Calcutta, all of these large machines run at the almost incredible speed of fifty revolutions per second. Three novel and interesting motor-alternator sets have been supplied for operating the Sperry gyroscope equipments on the Italian liner *Conte di Savoia*. The replacement of human effort by automatic electric control is proceeding very rapidly. The steam pressure in the boilers is maintained at the desired value by automatic regulation of the fans and grates. Substations are sometimes left entirely unattended, the starting, synchronising, and stopping of 14,000 kva alternators being entirely automatic. The first section of the power station the company is building for Montevideo is now operating. It is interesting to note that the whole of the work from the commencement of the excavation of the site to the starting up of the plant was carried through in sixteen months. This performance is excellent considering the distance the bulk of material had to be shipped.

#### Science Talks by Gramophone

SCIENCE teaching in schools in the United States is to be enlivened by the employment of gramophones for bringing to the class-rooms the voices of the most eminent men of science. The records are being produced by Science Service, of Washington, D.C. The "Durium" record used consists of a thin layer of a synthetic resin so strong that the sound grooves can be placed very close together, nearly doubling the time of playing. We have received a set of the first seven records, and listened to them with pleasure. The recording has been excellently done, and each speaker gives the kind of talk that would be expected from him were he invited by a teacher to address a class for five minutes. The speakers in this first set are Prof. Robert A. Millikan, director of the Norman Bridge Physics Laboratory, California Institute, Pasadena, on "The Rise of Physics", Prof. John C. Merriam, president of the Carnegie Institution, Washington, on "The Record of the Rocks", Prof. Edwin G. Conklin, professor of zoology in Princeton University, on "The Mystery of Life", Prof. Karl T. Compton, president of the Massachusetts Institute of Technology, on "Science and Engineering", Prof. L. H. Baekeland, pioneer in industrial chemistry, on "Chemistry and Civilization", Prof. William H. Welch, professor of the history of medicine in Johns Hopkins University, on "The Tubercle Bacillus", and Dr. William M. Mann, director of the National Zoological Park of the Smithsonian Institution, Washington, on "Our Animal Friends". With each record is supplied a card,

bearing on one side a photograph of the speaker and on the other side bibliographical details of his scientific work, together with the complete text of the talk. The set is being offered at an inclusive charge of three dollars, and, at such a low price, may be recommended not only to teachers and students, but also to anyone interested in science in general

#### Co-ordination of Scientific Terminology

AMONG the scientific questions which the International Institute of Intellectual Co-operation has been asked to examine is the co-ordination of scientific terminology. Various international organisations, including the Commission of Electro-technics and certain scientific unions, have undertaken, each in its respective sphere, the compilation of scientific or technical vocabularies. The different branches of science, however, constantly employ, and very often with a different meaning, terms which are common to all of them. It therefore appeared indispensable that the co-ordination of these terms should be undertaken. For this purpose, a Committee recently met at the International Institute of Intellectual Co-operation. It was composed of Prof Cabrera (Madrid, chairman), Prof Cotton (Paris), representing the International Union of Physics, Prof Willstatter (Munich), Prof Lowry (Cambridge), delegates of the International Union of Chemistry, Prof Selys-Longchamps and Dr Ledoux (Brussels), representing the International Union of Biological Sciences, and Prof Lombardi (Rome), delegate of the International Union of Electro-technics. The Committee invited the International Institute of Intellectual Co-operation to undertake the work of co-ordination in conjunction with the international organisations concerned.

#### Fourteenth International Physiological Congress

THE Fourteenth International Physiological Congress will be held in Rome on Aug. 28–Sept. 3, as arranged, no change has taken place in the date fixed for it. The president of the Congress is Prof Bottazzi of Naples, and the International Committee consists of Profs Pavlov (Russia), Johansson (Sweden), Howell (United States), Frank (Germany), Lapicque (France), and A V Hill (Great Britain). The inaugural ceremony will be held in the Grulo Cesare Hall of the Campidoglio. The inaugural lecture will be given by Prof A V Hill, and receptions will be given by the Governor of Rome and the Royal Academy of Italy. Foreign participants in the Congress will enjoy a reduction of fifty per cent for tickets taken, under certain conditions, on the Italian railways. In the near future, those who have already returned their applications for membership will receive further information, and a programme of the inaugural ceremony and other functions.

#### Announcements

It is announced in *Science* of March 18 that Sir James Jeans has been made an honorary member of the Washington Academy of Sciences, in recognition of his contributions to the dynamical theory of gases, to cosmogony, and to astrophysics.

THE William H. Nichols Medal for 1932 of the New York Section of the American Chemical Society was presented on March 1 to Prof J. B. Conant, chairman of the division of chemistry in Harvard University, in recognition of his work in organic chemistry, particularly in the chemistry of chlorophyll.

At the annual general meeting of the Physical Society, held on March 18, the following officers were elected: *President*, Prof A. O. Rankine, *Secretaries*, Dr Ezer Griffiths (Business), Dr Allan Ferguson (Papers), *Foreign Secretary*, Prof O. W. Richardson, *Treasurer*, Mr R. S. Whipple, *Librarian*, Dr J. H. Brinkworth.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned—A male assistant in the Department of Printed Books of the National Library of Wales—The Librarian, National Library of Wales, Aberystwyth (April 12). A registrar of the Wigan and District Mining and Technical College—The Principal, Wigan and District Mining and Technical College, Wigan (April 15). A director of education for the City of Sheffield—The Director of Education, Leopold Street, Sheffield (April 16). A Dickinson research travelling scholar in medicine, a Dickinson research surgery scholar, and a Dickinson research scholar in medicine, each at the Manchester Royal Infirmary—The Secretary to the Trustees, Royal Infirmary, Manchester (April 16). A head of the Commerce Department of the Wigan and District Mining and Technical College—The Principal, Wigan and District Mining and Technical College, Wigan (April 18). A full-time lecturer with degree, and a knowledge of general engineering or mining, at the County Technical Institute, Worksop—The Principal, County Technical Institute, Worksop (April 21). A junior scientific officer in an Admiralty establishment at Portsmouth—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W. 1 (April 23). Probationary assistant naval constructors—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W. 1 (April 30). An assistant in the Department of Forestry of the University College of North Wales—The Registrar, University College of North Wales, Bangor (May 9). A professor of physiology at the London Hospital Medical College—The Academic Registrar, University of London, South Kensington, S.W. 7 (May 14). A head of the Mechanical and Electrical Engineering Department of the Harris Institute, Preston—The Principal, Harris Institute, Preston (June 1). An assistant lecturer in civil engineering, building construction and sanitary science at the Battersea Polytechnic—The Principal, Battersea Polytechnic, S.W. 11. An assistant master for elementary engineering and metalwork at the Sawston Village College—The Education Secretary, County Hall, Cambridge. A temporary junior assistant with first or second class honours in physics, or equivalent, at the Experimental Station, Porton, near Salisbury—The Chief Superintendent, Chemical Defence Research Department, War Office, 14 Grosvenor Gardens, S.W. 1.



### Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

#### Palæacariformes, a New Sub-order of the Acari

THE discovery of the two genera of Acari for which it has been necessary to create this new sub-order affords us ample evidence of the truth of the contention that our knowledge of the teeming world of microarthropods is as yet very insufficient. A thorough exploration of the fauna of the tropics by the use of the modern method of automatic collecting, devised by the late Prof. Antonio Berlese of Florence, will undoubtedly yield a rich crop of many new and strange forms which will substantially alter our conceptions regarding these creatures.

One of the genera for which the new sub-order had to be erected, *Archeonothrus*, was discovered by me in 1905 in Natal, and a brief preliminary description of it was published in 1906,<sup>1</sup> the name implying that it was considered related to the Oribatid genus, *Nothrus*, although more primitive. The re-examination of this form last autumn, following on an investigation of the mouth-parts of the Oribatids,<sup>2</sup> revealed, however, at once such a large number of differing features that it soon became evident that the genus could not possibly be referred to any of the existing sub-orders of Acari. At the same time I was convinced that *Archeonothrus* must be considered the most primitive of recent Acari, presenting as it does the very aspect of a living fossil the nearest relative of which must be sought for amongst the fossil Acari from the Devonian epoch.

This discovery was eclipsed by the later surprising discovery of yet another genus of the new sub-order, this time in the soil in a spruce forest in southern Sweden, a genus which I have called *Palæacarus*.

In their general appearance both forms resemble very much the nymphæ of Oribatids, this very deceptive resemblance being due to the soft cuticle, the presence of pseudostigmatic organs, although of a more primitive type, and the long hairs on the hysterosoma.

The body is divided into two parts, the propodosoma and the hysterosoma, between which there is a distinct neck-shaped constriction. The propodosoma is covered by a shield which has five pairs of hairs besides the pseudostigmatic organs. Such a large number of propodosomatic hairs is very unusual in the recent Acari, but occurs also in the Devonian *Protacarus* described by Stanley Hirst from the Old Red Sandstone, a feature which lends support to the view held by some acaridologists that the propodosoma consists of six segments besides the acron.

The isolated position as well as the primitive organisation of the Palæacariformes is most clearly realised when one examines their maxillæ. In these there is no trace of the so-called hypostome which is such a conspicuous feature in the Oribatids, but, on the other hand, there are two pairs of appendages, the lateral ones of which are evidently homologous with the so-called maxillary lobes of the Oribatids and the Mesostigmata, while the median appendages are conspicuous through the presence of three pairs of hairs. In the Oribatids the maxillary lobes are enormously developed and meet in the middle, thus completely concealing the median appendages, the presence of which had previously been completely overlooked, but which I was able to discover by dissecting these organs, once the presence of them in the Palæacari-

formes had rendered it likely that they occurred also in the Oribatids. As regards the presence of two pairs of maxillary appendages, the Palæacariformes agree with the most primitive Trombidiformes, for example, *Speleorchestes*.

The new sub-order is undoubtedly related to the most primitive Oribatids. Thus the shape of the chela of the mandible, as well as the easily recognisable content of the hind part of the alimentary canal, is a sufficient proof that they are phytophagous, feeding probably on decaying leaves or possibly on mosses and lichens. But from the Oribatids they differ profoundly in the absence of hypostome and epimera and still more by the respiratory organs, which consist of a pair of minute stigmata on the base of the mandibles exteriorly and short tracheæ.

It is on the whole evident that the Palæacariformes show affinity to the more primitive forms of both the Oribatid and the Trombidiformes. The genus *Protacarus* mentioned above was placed by Hirst amongst the Eupodidæ, which are, however, in my opinion too specialised to be taken into account. As a matter of fact, *Protacarus* agrees in many respects in a striking way with the Palæacariformes, especially *Palæacarus*, as, for example, in the number of hairs on the propodosoma, the presence of pseudostigmatic organs, and, although Hirst could not discern clearly the shape of the chela of the mandible, he describes it as dark-coloured, which is precisely the colour of the chela of the phytophagous Oribatids and of *Palæacarus*.

It is admittedly premature to draw any far-reaching conclusions regarding the phylogeny of the Acari from the facts established by the discovery of *Protacarus* and the Palæacariformes, and the very discovery of the latter, however unexpected, must make it seem quite within the bounds of possibility that other forms may yet be discovered, representing new types which will remodel our present conceptions regarding the relationship of the different sub-orders with one another and concerning the origin of the Acari.

Nevertheless, the dim outline of the ancestor of at least the Oribatids, the Tyroglyphids, and the Trombidiformes seems to begin to materialise in the shape of a creature not unlike *Protacarus* and the Palæacariformes, whereas the connexion between these groups and the Mesostigmata and the Holothyrioidea seems very obscure.

IVAR FRAGÅRDH  
(Chief Entomologist)

Royal Swedish Forest Experiment Station,  
Feb 11

<sup>1</sup> *Zool Anz*, Bd 30, No 26, pp 870-871.

<sup>2</sup> Concerning the Mouth-parts of the Oribatids. *Entom Tidskrift*, pp 204-217, 1931.

#### Function of the Adrenal Medulla

ADRENALINE, as it is generally known to-day, seems to be different from the substance primarily produced by the adrenal gland. Adrenaline appears to be a decomposition product of the natural substance, the decomposition taking place post-mortem in the gland and during subsequent chemical manipulations. If the glands (ox) are collected and the extraction carried out in the usual way, adrenaline is obtained. If, however, the chances for post-mortem enzymic reactions are minimised by rapid excision and cooling of the glands after death, a substance is obtained by careful extraction the physiological action of which is distinctly different from that of the ordinary adrenaline. We propose to call this new substance 'novadrenaline'.

As is known, small doses of common adrenaline, of about 0.001 mgm, given intravenously to the decerebrated or anaesthetised cat, usually produce a fall of blood pressure. Only larger doses cause a definite

rise Novadrenaline does not show this depressor action of small doses. Even doses fifty times smaller give still a definite pressor effect.

If larger doses are given (0.05 mgm. with cut vagi), novadrenaline always produces a higher rise of blood pressure than the corresponding amount of adrenaline, as determined by colorimetric comparison. A striking difference between the actions of the two substances is seen also in the duration of their pressor effects. While with common adrenaline (0.05-0.1 mgm.) the blood pressure, after reaching its maximum, quickly returns to the original level, the rise of blood pressure produced by an equal dose of novadrenaline subsides only very slowly, often with a wide plateau lasting for several minutes, reaching the original level in 8-10 minutes, the return being three to four times slower than with adrenaline. As shown by I. Huszák in this laboratory, the action of novadrenaline on the Trendelenburg frog preparation is much stronger than that of adrenaline.

The difference between the action of adrenaline and that of our extracts cannot be due to the modifying influence of some accompanying substance, since on further purification the action of novadrenaline remains unchanged.

Our extracts were made with  $\frac{1}{2}$  per cent trichloroacetic acid, 2 c.c. being used for every gram of the minced medulla. The suspension was quickly heated to 80° C. and rapidly cooled again. The neutralised extract could be concentrated *in vacuo* to a syrup, and fractionated with methyl alcohol and acetone. From the acetone, novadrenaline was precipitated as a ferrous complex, the formation of which is highly specific for the *ortho* dihydroxy grouping. The active substance was liberated in watery solution from this complex by hydrogen sulphide, and still showed an unchanged activity. If once extracted and kept cool, novadrenaline is reasonably stable.

As to the chemical nature of novadrenaline, no more than a mere suggestion can be given at present. The evidence available suggests that novadrenaline is a low molecular weight ester of adrenaline, the esterifying radicle being attached to the alcoholic hydroxyl of the side-chain. This suggestion is based on the following observations. The general chemical properties of adrenaline and novadrenaline are very similar. The specific activity of novadrenaline can be destroyed by treatment with hydrochloric acid. As shown by the iron colour reaction, the *ortho* dihydroxy grouping is free in novadrenaline, as in adrenaline. Since the entire physiological activity of novadrenaline is destroyed by formaldehyde, the imino group seems also to be free.

As to the physiological importance of novadrenaline, it seems to be not unlikely that this substance presents, with respect to adrenaline, a relation analogous to that of acetylcholine to choline, with an activity related, however, in this instance, to the true sympathetic nervous system.

We hope that our findings may contribute not only to knowledge of the action of sympathetic nerves, but also to the understanding of pathological conditions, such as hypertonia and asthma.

We were led to the finding of novadrenaline by the study of oxidation processes, but were greatly helped in our work by a personal communication from Sir H. H. Dale, relating to a casual observation of the more persistent pressor action of extracts from the adrenal gland, in comparison with that of chemically isolated adrenaline. Our work has been supported by the Ella Sachs Plotz Foundation.

J. L. SVIRBELY

A. SZENT-GYORGYI

Institute of Medical Chemistry,  
University of Szeged, Hungary

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### Gill-Morrell and Barkhausen-Kurz Oscillations

IN NATURE of Feb. 6, Mr. R. Cockburn has described results which appear to show the presence of two types of electronic oscillations in a triode with positive grid voltage.

I should like to express disagreement with this result, for the following reasons.

(1) Mr. Cockburn's results shown in his Fig. 2 have been obtained by the simultaneous variation of two quantities, circuit length and filament emission, and present a misleading picture of the relation between circuit tuning and wave-length.

The apparent overlapping of the so-called Gill-Morrell and Barkhausen-Kurz oscillations is due to the dependence of the space charge oscillation frequency on emission current. Fig. 10 of Hollmann's paper<sup>1</sup> quoted by Mr. Cockburn shows the true nature of this effect.

(2) The variations of wave-length and amplitude with circuit tuning have been satisfactorily explained as 'coupled circuit' effects.<sup>2</sup> The hypothesis of two different types of oscillation is therefore unnecessary.

(3) There appears to be no valid experimental evidence for the existence in gas-free tubes of oscillations independent of the inter-electrode impedances ('B-K' oscillations), and existing theories<sup>3</sup> show that such oscillations are impossible.

(4) The simultaneous existence of two types of oscillation (apart from harmonics) has, so far as I am aware, never been demonstrated. I have shown elsewhere<sup>4</sup> that apparent experimental evidence<sup>1</sup> of this is untrustworthy.

Regarding the effect of varying the emission current, theory and experiment<sup>2</sup> have shown that the oscillation amplitude is a maximum in the region of the transition from space charge to emission saturation of the grid current characteristic. The presence of more than one optimum value of emission current usually indicates the presence of 'harmonic' space charge oscillations,<sup>5</sup> that is, oscillations of frequency nearly, but not necessarily exactly, an integral number of times that given by the Barkhausen-Kurz equation. 'Overtones' is possibly a better name than 'harmonics' for these oscillations.

It is probable that such oscillations occurred in the cases mentioned by Mr. Cockburn. The fact that the wave-length was shorter at the lower emission value (which is the opposite of the normal result where only fundamental oscillations are concerned) favours this hypothesis.

E. C. S. MEGAW

Research Laboratories of the  
General Electric Company, Ltd.,  
Wembley, Feb. 11.

<sup>1</sup> Hollmann, *Ann. Phys.*, **86**, 129, 1928.

<sup>2</sup> Tank and Schiltknecht, *Helvetica Phys. Acta*, **1**, 110, 1928.

<sup>3</sup> See, for example, Möller, *Jahrb. drahtl. Tel.*, **34**, 201, 1929.

<sup>4</sup> Paper to appear shortly, probably in *Jour. I. E. E.*

<sup>5</sup> Potapenko, *Z. tech. Phys.*, **10**, 542, 1929.

In my original letter (NATURE, Feb. 6), only the actual fact of the existence of two types of oscillations was mentioned, with perhaps insufficient explanation. In view of Mr. Megaw's letter, however, I feel that more details should be given.

Mr. Megaw explains the results as due to the variation of space charge oscillation frequency with emission current, suggesting, presumably, that a maximum in the amplitude of the oscillations would be obtained quite normally when this frequency corresponds to that of the external circuit. Perhaps it was not made sufficiently clear that the ranges of emission current for the two types of oscillations are quite distinct.

For example, with  $V_g = 40$  v,  $V_a = 0$  v, the space

charge saturation current is in the neighbourhood of 20 ma. The optimum emission for the maintenance of the 130 cm Barkhausen-Kurz wave is fairly constant at 16 ma for variations of the tuning circuit, except at points A (Fig 2, previous letter), where it drops to 14 ma, corresponding to the drop in wave-length noticeable at these points. In the Barkhausen-Kurz zone, therefore, the oscillations are a maximum in the neighbourhood of space charge saturation of the grid current characteristic, in agreement with the results of Tank and Schiltknecht mentioned by Mr Megaw. The secondary optimum emission value maintaining approximately the same wave-length is 8 ma. The emission range for optimum maintenance

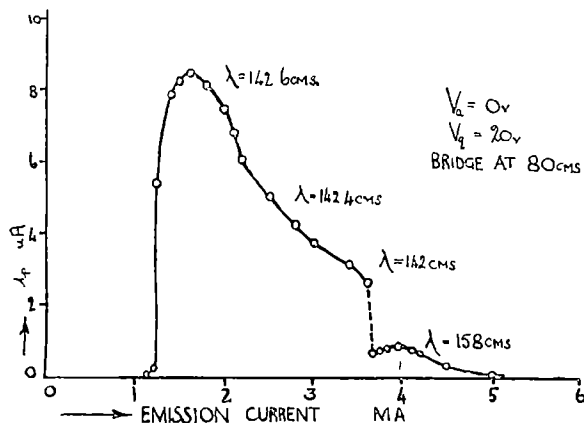


FIG 1—Variation of plate current (and wave-length) with emission current

of the Gill-Morrell oscillations is continuous from 1 ma to 11 ma, the wave-lengths extending from 90 cm to 170 cm. The emission for optimum maintenance of a wave-length of 130 cm in this zone is 3 ma.

With the tuning bridge fixed in such a position as to offer a wave-length suitable for maintenance in the Gill-Morrell zone and variation of emission current, usually a sudden change in plate current, together with a change in wave-length, is noticed as the oscillations change from one type to the other. A clear example is shown in Fig 1.

It is not at present possible to offer a full explanation of the existence of the two zones. However, it has been shown<sup>1</sup> that electron oscillations can occur in the grid-anode space when it is space charge saturated, and in the valve used the dimensions were such as to permit this state to exist. If, then, oscillations can occur in the anode-cathode space as well, there would appear to be sufficient justification for postulating the existence of two types of oscillations. Fundamentally, no doubt, they are due to the same basic cause, and if in his forthcoming paper Mr Megaw co-ordinates the various conflicting experimental results, a distinct advance will have been made.

R. COCKBURN

Municipal College,  
West Ham, E 15,  
Feb 15

<sup>1</sup> Gill, (a) A Space Charge Effect, *Phil Mag*, Ser 6, 49, 993, 1925  
(b) Electrical Oscillations of Very Short Wave-length, *Phil Mag*, Ser 7, 12, 843, 1931

#### Light as a Factor in Sexual Periodicity

REFERRING to the recent papers and communications of Dr J. R. Baker and Mr R. M. Ranson and Prof T. H. Bissonette, read before the Royal Society, Feb 4, Dr Marshall<sup>1</sup> suggests that the conclusion concerning light as a factor governing sexual periodicity involves a principle of wide application.

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In view of this remark, it may be of some general interest to biologists to know that so far as the flowering plants are concerned this holds true.

Since a brief account of the earlier work on these lines was published in 1924,<sup>2</sup> further investigations have been carried out, and more than one hundred varieties and species have now been tested in Great Britain, whilst in America, Russia, and elsewhere similar work has been done. The results have appeared in various botanical periodicals.

Briefly, it appears that the period of light exercises a profound influence upon the habit of growth, and determines whether many plants flower or remain in the vegetative condition. Under an unfavourable period of light, the formation of sexual organs may be suppressed for very long periods during which vegetative growth continues (Garner and Allard). The flowering plant is so organised morphologically that the response can be strictly localised to one part (Knott). The distribution of the sexual organs in the plant may also be controlled in another manner, as, for example, in hemp, where 'sex reversal' may occur, or in cucumber, where the sex ratio may be modified as a result of the influence of the period of light (Schaffner).

All observers record that the utilisation of the food products, whether in storage or in rapid growth, reflects the operation of this factor, which may also govern the rate of tuber formation (Maximov).

I am unaware that much information has as yet been collected from studies made with cryptogams. However, in the Hepaticæ (Liverworts) the formation of sexual organs and their supporting tissues is at least partially controlled by this factor (Wann).

Possibly the well-known periodicity of the plankton (diatoms, peridneans, and crustaceans) would also provide an interesting series of observations when studied under varying conditions of light and constant temperature, salinity, etc. M. A. H. TINCKER

Royal Horticultural Society,  
Wisley, March 5

<sup>1</sup> NATURE, 129, 344, March 5, 1932

<sup>2</sup> M. A. H. Tincker, NATURE, 114, 350, Sept 6, 1924

WITH reference to the letter of Dr F. H. A. Marshall on the above subject,<sup>1</sup> I should like to direct attention to the relation of sexual maturity in marine invertebrates to the phases of the moon, a relation which was stated to exist many years ago and seemed at first scientifically incredible and imaginary, but which has been more recently verified by exact research carried out by several competent marine zoologists. The most famous case is that of the Palolo worm, *Eunice viridis*, the sexually mature posterior parts of which swarm at the surface of the sea off the islands of Samoa and Fiji in the mornings of the seventh, eighth, and ninth days after the full moon of November. The most recent paper on the subject is that by Silvio Ranzi of the Zoological Station of Naples.<sup>2</sup> In many other species of Polychæta the sexual maturity and discharge of mature ova and sperms has been shown to synchronise with particular days of the lunar cycle, but in some localities certain species show no evidence of such a relation.

Ranzi's own researches were made on *Platynereis dumerilii*, in which he found that mature individuals occur at Naples from March to November, but that the greatest number of spawning individuals occurred on the third day after the full moon. Sexual maturity is thus not confined to one lunar month of the year in all cases as in the Palolo, but the sexual cycle is affected by the lunar cycle.

Ranzi concludes that the sexual cycle of marine annelids is influenced by a lunar factor, which cannot be the tide, because it occurs in the Mediterranean, where the tides are negligible, nor the light, because sunlight has no such effect. He suggests, therefore, that the influence of the moon is due to some action of unknown nature, not perceptible to our senses, but producing an effect on the sexual cycle of organisms. The facts would suggest that the effect is due to some peculiarity of moonlight which is absent from sunlight, and here is a question which bio-physicists might investigate. Moonlight is, I believe, polarised, but I do not know that any attempt has been made to test the effect of polarised light on the sexual cycle of living organisms.

J. T. CUNNINGHAM

35 Wavendon Avenue, W 4,  
March 14

<sup>1</sup> NATURE, 129, 344, March 5, 1932.

<sup>2</sup> *Pubblicazioni della Staz. Zool. di Napoli*, vol. 11, Fascicolo 2, 1931.

### Stomatal Movement and Hydrogen Ion Concentration

In order to test the effect of the hydrogen ion concentration of the cell-sap on stomatal movement, experiments were made with the stomata of *Tulipa*, *Scilla*, *Iris*, and *Tradescantia*. It was found that the hydrogen ion concentration of the cell-sap of the guard-cells was approximately 4.5, while the epidermal cells were slightly less acid. The stripped epidermis was placed in buffer mixtures of known hydrogen ion concentration and left for two, six, twelve, and twenty-four hours respectively. The mixture used was the B. D. H. 'Universal Buffer Mixture'. For each time interval, one set was kept in the light and another in the dark for comparison. It was found that, in the case of *Tulipa*, the stomata were closed between pH 1 and pH 5, and at pH 6, 7, and 9 they were open, the maximum being at pH 7. In the dark the stomata were open at pH 5, 6, 7, and 9, the maximum being at pH 5. In the case of *Scilla*, the closure continued up to pH 6 in light, to pH 5 in the dark, with a maximum at pH 7.

In order to avoid the possibly toxic effects of the buffer mixture, the experiments were repeated with solutions of carbon dioxide, of pH values 4.4, 4.6, 4.8, and 5.0. In all these, the stomata of *Tulipa* were open, the greatest opening being at 4.4 in light and 5.0 in dark. *Scilla* showed closure at pH 4.4 and 5.0 in light and dark, opening at 4.6 and 4.8. *Iris* stomata were open throughout the whole range in light, and closed at 4.8 and 5.0 in dark, with a maximum opening at 4.4. *Tradescantia* showed a maximum opening at 4.4 in light, and closed at 4.4 in dark, with greatest opening at 5.0.

It is evident from this that the stomata of these forms are susceptible to changes in the pH value of the sap produced by carbon dioxide, and that the guard-cells respond by movement to these artificially produced changes. The experiments of which this is a preliminary account are still in progress, and it is intended to extend the observations to dicotyledons as well as to monocotyledons.

E. PHILIP SMITH

M. S. JOLLY

University College, Dundee,  
March 3

### A Virus Disease of Tobacco in South Africa

AN obscure and destructive disease of tobacco has occurred for many years in the Stockenstrom district of the eastern Cape Province. It is becoming yearly more serious, and frequently causes total loss of both seed-beds and early plantings. Recent investigation has shown that it is a virus disease which, although

bearing some resemblance to the 'ring-spot' described by Smith<sup>1</sup> and Wingard,<sup>2</sup> has important distinctive characters of its own.

A constant symptom of the disease is the sudden stoppage of apical growth and the stunting of leaves in process of formation. Leaf-spotting develops along various lines, but is usually of a 'ring-spot' or hieroglyphic type, often definitely related to the veins in a fern-leaf pattern. The youngest leaves show marked distortion and blistering, frequently accompanied by brilliant mottling. General chlorosis is usual in varieties of the Burley type, and is followed by discoloration of the stem in cortex and pith and by root decay associated with secondary organisms. Affected plants either die outright or survive through the season in a stunted condition. Some plants show a partial recovery, and after an interval make new growth from terminal or lateral shoots.

The disease can only very rarely be transmitted by needle puncture, but is readily induced by insertion of a diseased shoot (such as for grafting). It is, however, most easily transmitted by the feeding of a member of the thrips group (*Frankliniella*, species undetermined), and under field conditions this insect appears to be the sole vector. The green aphid common in seed-beds does not transmit the disease.

In the same locality, a tomato disease is prevalent which appears to be identical with the spotted wilt of Australia.<sup>3</sup> Distinctive diseases of *Datura Stramonium*, *Physalis* (two species), and *Nicandra physalodes* also occur in the field and are transmitted by the same insect vector. From cross-inoculation studies in progress, there is every indication that all six diseases are caused by one and the same virus.

E. S. MOORE

Department of Agriculture,  
Tobacco Laboratory,  
Balfour (Cape), South Africa,  
Feb. 1

<sup>1</sup> Smith, *Ann. Appl. Biol.*, 16, 382, 1929.

<sup>2</sup> Wingard, *J. Agri. Res.*, 37, 127, 1928.

<sup>3</sup> Samuel, Bald, and Pittman, *Bull. 44, Coun. Sci. Ind. Res. Australia*, 1930. See also NATURE, 128, 494, 1931.

### Oviposition of *Telenomus nigrocoxalis* Aschm. (Chalcididae)

*Telenomus nigrocoxalis*, a hymenopterous egg-parasite of the Coconut butterfly in British Guiana (*Brassolis sophorae* L.), was observed under magnification on an egg-mass of the host. After a careful inspection and tapping of the eggs with her antennae, the female decides upon a particular egg and penetrates the shell dorso-laterally with a few strokes of the ovipositor, which is inserted into a minute puncture. The female remains in this position for about four minutes. Now and then a male stops to tap the female on the head and thorax with his antennae.

One female, probably an old one, was unable to extricate her ovipositor and, after about ten minutes in this awkward position, collapsed and lay apparently dead between the eggs. Presently a male happened upon her, and immediately showed the greatest concern for the unfortunate female. His agitated movements in attempting to revive the female and distracted behaviour were quite touching. A speck of water, accidentally left with my brush on an adjacent egg before this incident occurred, was now noticed apparently for the first time. By means of one of his antennae the male applied some of this water to the prostrate female.

This movement was repeated many times, but without great success, for there was no sign of life yet and the ovipositor was still held by the egg. Another male appeared on the scene and immediately took in

the situation. Perhaps he has had a similar task before. He seized the female by the ovipositor and with the help of the other male dragged it out, and walked off quite unconcerned. The female brushed herself and made off in another direction, followed by a grateful male tapping her affectionately with his antennae.

F. A. SQUIRE

Dept of Agriculture, Georgetown,  
British Guiana, Feb. 17.

#### Polish on Metals

MR R. C. FRENCH has reported on electron diffraction experiments on polished metal surfaces (copper, silver).<sup>1</sup> The fact that the diffraction rings become more and more diffuse if the surface is carefully polished is, he concludes, an experimental confirmation of Sir George Beilby's theory, which supposes that by careful polishing a metal surface is covered with a thin amorphous layer of the metal as a supercooled liquid. Mr H. Raether, who is working in this laboratory with a diffraction apparatus,<sup>2</sup> has got similar results with polished metals. I do not, however, believe that for the explanation of these results it is necessary to suppose that the size of the crystals which constitute the surface is really altered so very much by the process of polishing. I should like to suggest a simpler explanation. A polycrystalline metal surface which is bombarded with electrons at a grazing angle gives sharp diffraction rings if the surface consists of small lumps which are thin enough to allow the electrons to pass through; this was first shown by Prof G. P. Thomson.<sup>3</sup> The lumps play the rôle of the grating, and if by polishing the metal they are levelled, the resolving power of the gratings is gradually diminished (corresponding to the diminished breadth of the gratings).

The sharpness of the diffraction rings proves nothing, therefore, about the real size of the crystals, but gives definite information of the degree of levelling of the surface. Finally, if at the highest degree of polishing the lumps have wholly disappeared, the diffraction would be a specular reflection on the plane surface of the polycrystalline target. In this case refraction would occur and cause a considerable shift of the interference maxima—which would also be broadened—and probably the vanishing of (111) and (002), however, this seems not to be realised in the present experiments, and requires further investigation.

F. KIRCHNER

Institute for Theoretical Physics,  
Munich, Feb. 5

<sup>1</sup> NATURE, 129, 169, Jan. 30, 1932.

<sup>2</sup> F. Kirchner, *Ann. Phys.*, 11, 741, 1931.

<sup>3</sup> G. P. Thomson, *Proc. Roy. Soc. A*, 128, 650, 1930.

IN connexion with Mr French's work on polished metal surfaces<sup>1</sup> and Prof Kirchner's very interesting suggestion above that diffuse diffraction rings may be due to extreme flatness of the surface rather than to an amorphous state, we should like to mention some results which we have recently obtained.

Surfaces of platinum spluttered on glass have been examined by electron diffraction; they show various patterns, of which one is that given by platinum in its ordinary state. If the platinum is spluttered in oxygen at a voltage not exceeding about 1150 and a pressure of not less than 0.014 mm., the surface is active in promoting the combination of hydrogen and oxygen by catalytic action. Such surfaces show at first diffuse rings very similar to those found by French for polished metals, but after the surface has been used as a catalyst until its activity is lost, these diffuse rings change to the sharp rings characteristic of normal platinum. This change is also produced by heating *in vacuo*.

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It is unlikely that these diffuse rings are due to an extremely flat platinum surface, which one would not expect to be catalytically active, and we find that the change from diffuse to sharp rings is accompanied by an improvement in the specular reflection, suggesting that the surface gets smoother rather than rougher. It seems more likely that the diffuse rings are due to some substance in a state of very fine subdivision, with perhaps inclusions of gas molecules.

C. A. MURISON  
N. STUART  
G. P. THOMSON

Imperial College of Science,  
S. W. 7, March 22

<sup>1</sup> NATURE, 129, 169, Jan. 30, 1932.

#### Non-polar Auroral Light from the Night Sky in the Tropics

IN a previous communication from one of us,<sup>1</sup> it was stated that the brightness of the auroral green line in the northern and southern night skies at Poona (lat. 18° 31' N) does not show the midnight maximum observed by Lord Rayleigh and by McLennan and his collaborators in temperate latitudes. Further estimates of intensity obtained by exposing Mimosa extreme orthochromatic plates through suitable green and orange filters, and with an aperture of about 45° towards the zenith, shows definitely that, in general, the brightness of the overhead sky gradually decreases from sunset to a minimum at about midnight, and increases after midnight.

To test whether the result was due to admixture with zodiacal light (it is questionable whether we should consider it as separate from night sky light), simultaneous photographs were taken on a few occasions of the spectrum of the sky with the spectrograph pointed approximately towards the pole star. These confirm that even in the north sky there is a distinct minimum of brightness within an hour of midnight. It may be mentioned that the nights were all perfectly clear. Occasional casual variations, such as have been noted by various observers in Europe and America, also occur.

If the excitation of the green line is directly or indirectly due to ultra-violet light from the sun, one would *a priori* expect a minimum brightness of the sky some time after midnight depending on the height of the effective layer of atomic oxygen. The maximum brightness observed in temperate latitudes at about this hour is in need of adequate explanation.

K. R. RAMANATHAN  
J. V. KARANDIKAR

Meteorological Office,  
Ganeshkind Road, Poona 5,  
Jan. 14

<sup>1</sup> [NATURE, 129, 250, Feb. 20, 1932.]

#### Anomalous Diamagnetism of Bismuth

BISMUTH when electrically or mechanically colloidalised shows a fall in its diamagnetic susceptibility value.<sup>1</sup> Doubts were raised by Prof Bhatnagar as to whether this fall in value could not be due to oxidation.<sup>2</sup> It was shown by me<sup>3</sup> that though a large part of this value was certainly due to oxidation, still there was a decrease in value which could be explained only by attributing it to reduced particle size, as in the case of graphite.

The problem has now been attacked in a different manner. Colloidal bismuth, mechanically prepared and purified by treatment with tartaric acid and alcohol, was investigated in the following way: A small quantity was sealed *in vacuo* in a small glass bulb. The deflexion was noted in a Curie balance

having for comparison a standard benzene bulb. The powder was then melted, and recrystallised by heating the bulb in an electric heater to about  $270^{\circ}\text{C}$  and very slowly cooling it. After noting the deflexion due to the bulb with the resolidified bismuth, that of the container alone was determined by breaking it open and dissolving out the metal with nitric acid. Experiments with similar bulbs and bismuth regulus showed no change of deflexion after heat treatment. But when bismuth powder was melted and recrystallised, the diamagnetic susceptibility rose nearly to the regulus value. Many samples of colloidal bismuth gave similar results.

These observations indicate that the fall in the susceptibility value with reduction of particle size in the case of bismuth is a genuine effect. Full details of this investigation will be published elsewhere.

S RAMACHANDRA RAO

Annamalai University,  
Annamalainagar, Jan 28

<sup>1</sup> *Ind J Phys* 5, 559, 1930

<sup>2</sup> *Ind Chem Soc*, 7, 975, 1930

<sup>3</sup> *Ind J Phys*, 6, 241, 1931

### Photochemical Decomposition of Phosphine

It is rather surprising to find that, although the photochemistry of ammonia has attracted considerable attention since Warburg's<sup>1</sup> work, no corresponding experiments have been carried out with the equally simple molecule of phosphine. Such experiments have now been in progress in this laboratory for some time.

The absorption spectrum of phosphine consists of a region of continuous absorption beginning at about  $220\mu$  and continuing to  $185\mu$ , the limit of the spectrograph used. Preceding this continuous band there are three diffuse bands in the region  $220\text{--}230\mu$ . No fine structure is exhibited by these bands. The spectrum, like that of ammonia, would appear to be of the predissociation type.

Light from zinc or aluminium sparks readily decomposes the phosphine into hydrogen and phosphorus, which is deposited as the red variety on the walls of the insulation tube. The experiments on the direct photochemical decomposition have not yet been completed. The mercury photosensitised reaction has, however, been investigated in some detail. The rate of decomposition is about ten times that of ammonia under the same conditions. It is dependent on the diameter of the reaction tube, for, as the diameter is decreased—that is, the surface volume ratio increased—there is a decrease in the rate of decomposition. For example, in tubes of 2 cm, 1 cm, and 0.5 cm diameter, the rates are in the ratio 2.5 : 1.5 : 1. This would indicate that recombination of the products of dissociation occurs at the walls of the reaction tube. Argon has no effect on the velocity. On the other hand, oxygen increases the rate of decomposition as much as five times ( $p_{\text{PH}_3} = 0.05\text{ mm}$ ,  $p_{\text{O}_2} = 0.05\text{ mm}$ ), while the subsequent addition of argon (0.1 mm) still further increases this rate. These observations are most plausibly explained if it is assumed that oxygen attacks the products of dissociation, thus preventing their recombination. The resulting oxide molecules then initiate a stable chain reaction between the undecomposed phosphine and the oxygen.<sup>2</sup>

These results partly explain an interesting observation of Hinshelwood and Clusius,<sup>3</sup> who found that on illuminating a  $\text{PH}_3\text{--O}_2$  mixture below the lower critical explosion pressure, the pressure to which the mixture had to be compressed in order to obtain explosion was lower than that of the unilluminated gases. A mercury lamp with a chlorine-bromine

filter transmitting  $250\text{--}280\mu$  was used in these experiments. The effect was shown to have its origin in the phosphine molecule, but in view of the fact that phosphine itself does not absorb in the region  $250\text{--}280\mu$ , it would seem that the incidental presence of mercury vapour resulted in the phosphine being decomposed by excited mercury atoms into hydrogen atoms and probably  $\text{PH}$  or  $\text{PH}_2$  radicals, which produce the Hinshelwood-Clusius effect. Hinshelwood and Clusius concluded that the active material was present in the gas phase, but on repeating their experiment by exposing the mixture in one tube and determining the explosion pressure immediately after in another similar tube, the effect was not observed. That is, the effect is most probably a wall phenomenon, the illumination of the mixture producing a molecule or radical which is afterwards adsorbed on the walls, the latter are thereby enabled to reflect the chains more efficiently, thus decreasing the explosion pressure. It has also been found that pretreatment of the walls with atomic hydrogen results in a decreased explosion pressure.

H W MELVILLE

Chemistry Department,  
The University, Edinburgh, Feb 25

<sup>1</sup> *Sitzungsber Preuss Akad*, p 746, 1911

<sup>2</sup> Cf. Dalton and Hinshelwood, *Proc Roy Soc*, A, 125, 294, 1929

<sup>3</sup> *Proc Roy Soc*, A, 129, 589, 1930

### Structure of the Third Positive Group of CO Bands

THE third positive group of CO bands has been studied often before, but no satisfactory analysis of the bands seems to have resulted from it. Therefore we have photographed the bands in the second and third order of a 21-ft concave grating with 20,000 lines per inch. So far, we have studied the bands  $0\text{--}0$  to  $0\text{--}4$  with heads at 2833, 2977, 3134, 3305, and 3493 Å. The bands are due to a  $^3\Sigma\text{--}^3\Pi$  transition. The triplet separation of the  $^3\Sigma$  state is unnoticeable for  $J < 20$ . Under these conditions we must expect 15 branches if the resultant spin is not yet completely coupled to the rotational axis (transition from case *a* to case *b*). We found 13 of these branches and traces of the remaining two, which are too faint to be observed among the strong main branches. The five heads which are characteristic for the bands under low dispersion are the heads of the  $O_3$ ,  $O_2$ ,  $P_3$ ,  $P_2$ , and  $P_1$  branches (in the simplified notation of case *b*). The initial level shows very strong perturbations from about  $K = 16$  on, and slight irregularities also for very small  $K$  values. This fact makes an analysis of the higher lines of the bands much more difficult, and we have not yet completed this part entirely. The moment of inertia for the final state is  $16.5 \times 10^{-40}$ , and for the initial state approximately  $14.3 \times 10^{-40}$ . The character of the  $\lambda$ -doubling and the number of missing lines near the origin identifies the final electronic state as a regular  $^3\Pi$  state.

Our results are not in agreement with the analysis of Asundi,<sup>1</sup> who classified these bands as  $^5\Sigma\text{--}^5\Pi$  transitions. The fact, however, that the observed structure agrees perfectly with the theoretical expectation that practically all lines in the region investigated can be arranged into those branches, that all combinatorial relations are fulfilled within the limits of experimental errors, and that the perturbations of equivalent lines are identical in the sixty branches in which they occur seems to us a strong argument in favour of the correctness of our analysis.

Complete details will be found elsewhere.

G H DIEKE

J W MAUCHLY

The Johns Hopkins University, Jan 21.

<sup>1</sup> *Proc Roy Soc*, A, 125, 277, 1929



## Research Items

**Pigmentation of Sussex School Children.**—Dr W R Dunstan contributes to the *Medical Officer* (March 19, 1932) a survey of 18,349 children attending the elementary schools of East Sussex, comprising both rural and urban communities. He has found, as did Prof H J Fleure in his survey of the population of Wales, that there is a decided tendency to the differentiation of local types. In this community, usually regarded as one of pure Saxon descent, red hair occurred in 4.9 per cent of the children examined, round Heathfield there was 8 per cent of red-haired children, while in Rye there was only 3 per cent. Flaxen hair had a general incidence of 7.7 per cent, along the northern area examined by Dr Dunstan it rose to 10 per cent, in Uckfield it fell to 4 per cent. Black hair occurred in 6.7 per cent of the 18,000 children surveyed, in the schools of Newhaven it had an incidence of 16.7 per cent, in Uckfield 12 per cent, in Rye only 2 per cent. In most points observed, urban children had the same degree of colouring as the children of the neighbouring rural district. There were exceptions, however. Rather unexpectedly, there was a decided preponderance of flaxen-haired boys in the town schools, and also of black-haired boys and girls, as compared with the corresponding rural children. The maps which Dr Dunstan has prepared to show the distribution of hair and eye colouring reveal distinctive areas and zones. If a population is stationary as regards residence, a differentiation into local types is to be expected. Whether the increased industrialisation of the home counties will lead to the break-up of these 'local pockets' remains to be seen. Dr Dunstan's survey has demonstrated that they still persist in East Sussex.

**The Drum in South America.**—In South America the drum plays a very small part, and, indeed, it has been doubted whether it existed on the Amazon and in the Guianas in pre-Columbian days and may not have been entirely of European introduction. In the southern area it takes the form of a hollow membrane-covered vessel, which, curiously enough, is filled with water when it is in use. This form also occurs in the extreme east of North America. In ancient Peru, judging from the Chimu pottery figures, the drum was more prominent, though no examples have as yet been recovered from the ancient graves. Nordenfalk holds the opinion that the true Indian drum had a membrane on one side only. A Chiriguano specimen, now in the Goteborg Museum, is made from a hollow log, one end of which is open, while a circle of wood, covered with skin, fits closely to the other. It is evidently of Peruvian derivation. Harcourt, on the other hand, holds that the Peruvian drums had parchment on both sides. All doubt is set at rest by three specimens, hitherto undescribed, which are illustrated in the *Journal de la Société des Américanistes*, N S, t 23, fasc 1, by Dr Karl G. Izikowitz, who examines the whole question in some detail. One drum, now in the Hamburg Museum, comes from Quillagua, Northern Chile. It is probably made of a hollow log of wood (diameter 26 cm). It cannot be examined, as it is entirely covered with skin. The second, in the Munich Museum, is also completely covered with skin, but owing to its condition the method of construction can be seen. It is made of slats of wood fastened by threads to two rods, one above the other, bent to form an oval (long axis 29 cm). These might from their size have been the originals of the Chimu drums. The third specimen, now in the Goteborg Museum, is from Southern Peru, probably Ica. It is a terra-cotta vase

with skin over the expanding mouth. It is analogous to the water drums of the Chaco, and probably, like them, was filled with water when played.

**Life History of *Paralepis*.**—No 10, vol 2 (Biology) of the Report on the Danish Oceanographical Expeditions 1908–1910 to the Mediterranean and adjacent seas, under the superintendence of Dr Johs Schmidt, contains two memoirs, A 13 "The *Sudidae* (*Paralepis*)", by Vilh Ege, and A 14 "Carangidae", by W Schnakenbeck. The pelagic fish genus *Paralepis* inhabits the North Atlantic and the Mediterranean. The specimens collected embrace upwards of 13,000 specimens, mostly post-larvæ at different stages, with a certain number of very young forms. The author has elucidated the life-histories of all the species investigated which, except for very few larval and post-larval stages, were previously unknown, and represent ten species, three of which are new. The characters used for distinguishing the species are the number of vertebrae and fin rays, length of head, dentition, position of the fins, and the length of the pectorals. These characters can be recognised in most of the older post-larvæ. To link them up with the younger larvæ, the position and number of the chromatophores, which are very characteristic of the species, are used. The first part is an introduction, the second is systematic, and excellent figures are given of a series of young of each species and also of the jaws, the third part deals with the biology of the post-larvæ, their horizontal and vertical distribution at different times and in different places, with relation to temperature and the probable time of spawning. The specimen from Polkerris in Cornwall, described by Day (1880–84) as *Paralepis coregonoides*, has been examined and pronounced to be *Paralepis coregonoides borealis* Reinhardt, which the author regards as distinct from *Paralepis coregonoides coregonoides*, with a more northerly distribution. He is also of the opinion that the post-larva from the Bay of Biscay, recorded by Holt and Byrne (1906), is probably this northern species.

**The Structure and Division of Chromosomes.**—With advances in genetic theory, the detailed structure of chromosomes and the manner of their division have become matters of increasing importance. In a critical study of mitosis in the root tips of diploid and tetraploid forms of *Narcissus*, Dr S Hedayatullah (*J Roy Micro Soc*, vol 51, p 347) has made observations which throw light on previous views and give a consistent picture of the chromosome as a structure which is double throughout the mitotic cycle, splitting in each metaphase into halves, which will separate in the following metaphase. The chromosome is thus double both in anaphase and prophase and in the interkinesis stage between. Cytologists have frequently regarded the chromonema and chromomere hypotheses as mutually exclusive, but here it is shown that by the fusion of the chromomeres in early prophase a continuous chromonema is formed, which then splits longitudinally in metaphase. The two threads in the matrix of the chromosome begin to twist around each other in anaphase, and so form in telophase appearances which have been mistakenly interpreted as due to a process of alveolisation. In telophase the chromonemata untwine and become chromomeric, and the resting nucleus is essentially composed of strings of chromomeres running parallel in pairs, not forming a network in the true sense. The cleavage

of the chromonema in metaphase is regarded as bringing about the longitudinal division of the gene thread in each mitosis. The fact that the chromosome is at all times essentially a double structure composed of two threads will need to be taken into account in future interpretations of the phenomena of meiosis.

**Ore Deposits of Nevada**—An important structural and economic study of the mining district of Goodsprings, Nevada, has been made by D. F. Hewett (*Prof. Paper*, 162, U.S. Geol. Sur., 1931). Stratified rocks range from Upper Cambrian to Recent. In early Tertiary times folding occurred, followed by thrusting and injection of sills and dykes of granite-porphphy. Normal faults accompanied by ore deposition are succeeded by still later faults which are older than a series of middle Tertiary volcanic rocks of the andesite-rhyolite suite. The ores include gold, deposited in granite-porphphy and adjacent carbonate rocks, oxidised copper minerals with accessory cobalt, nickel and silver, some of which occur near the granite-porphphy masses, and lead and zinc sulphides and oxidised ores mostly remote from outcropping bodies of intrusive rock. The copper deposits lie in Devonian or older beds, while those of lead and zinc are concentrated in dolomitised limestones of Lower Carboniferous age. Apart from the regional zoning of the ores and the distribution of alteration there is nothing to prove a genetic relation between the intrusive rocks and the lead and zinc deposits. Such indirect evidence, however, points here, as elsewhere, to a deeply buried mass of igneous material as the source from which the ore-solutions ascended.

**Earthquake Frequency in Northern Europe**—In *Sveriges Geologiska Undersökning, Årsbok* (1930), No. 1, K. E. Sahlström publishes a new seismological map of Scandinavia and Finland, showing by different intensities of blue colouring the total number of earthquakes recorded in that region during the period 1600–1925. It is an extension of a map lately published by H. Renquist (*Z. Geophysik*, vol. 4, p. 7) for Finland, and is made on the same novel plan. The regions in which seismicity in recent centuries has been strongest are along the west coast of Norway, between Stavanger and Molde and in another narrow belt farther north, the country around Oslo and eastwards towards Lake Venern, and the region round the Bothnian Gulf. An interesting brief discussion of the cause of the marked seismic activity of certain limited regions and the seismic quiet of others is given.

**Magnetic Anomalies in France**—In the *Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau Central de Magnétisme Terrestre* (t. 9, Paris, 1931, pp. 210), eighteen papers on geophysics are included, together with the annual summaries of magnetic data from the two French magnetic observatories of Val Joyeux (for which hourly data are printed) and Nantes. Probably the paper of most novelty and interest is that on the anomalies of the earth's magnetic field over France, that is, the departures from the smooth distribution of isomagnetic lines most nearly fitting the observed field. This paper is illustrated by four charts showing, in colour, the anomalies in declination, inclination, horizontal force, and vertical force. In some of their main features these four charts show notable differences. The most striking anomaly is that in the 'Paris basin', extending in a narrow belt half-way across France, from the coast of the English Channel in a south-south-easterly direction. On the east of its centre line the declination is in excess,

and on the west in defect, by amounts surpassing half a degree in some places, the vertical force is in excess over the same region, and on both sides of the centre line, while the horizontal force shows no particular abnormality. The anomaly is not explicable in terms of the magnetic properties of the known geological strata in the region, and points to unknown influences deeper down.

**Monochromatic Atomic Waves**—Two ways for obtaining beams of atomic rays which have only a small range of velocities or de Broglie wave-lengths are described by I. Estermann, R. Frisch, and O. Stern in the *Zeitschrift für Physik* for Dec. 10. In one, a monochromatic beam of helium atoms is sorted out from a heterogeneous beam with a Maxwellian distribution by forming its wave-spectrum by diffraction at a crystal of lithium fluoride, and working only with diffracted beams coming off from the crystal within small angular ranges. In the other method, the Maxwellian beam is passed through a form of mechanical filter which consists of two parallel toothed wheels rotating on a common axis. This method, which has already been used by K. T. Compton and others, has given particularly good results with Prof. Stern's fine technique for this type of work, and has the great merit that the mechanical speed of the particles can be calculated from the speed of rotation and the geometry of the system. In this way, it has been found possible to verify rather closely that the distribution of velocities in the original beam conforms to Maxwell's theory, and to show that de Broglie's formula is correct to within two per cent for helium atoms, the diffraction being again performed at a lithium fluoride crystal.

**Some Properties of Cerium Ions**—We have received from Prof. D. M. Bose and S. Datta, University College of Science, Calcutta, a preliminary account of some new theoretical and experimental work bearing on the binding forces between atoms in crystals, exemplified particularly by the properties of the cerium ion  $Ce^{++}$ . Recent interest in this dates from the discovery made by de Haas and Becquerel, in 1929, that the magnetic rotation of the plane of polarisation by tysonite, which contains this ion, follows a modified Langevin formula which requires the effect to be due to a single electron bound in the ion in the simplest possible way, although Hund's theory shows that the state of the ion is decidedly more complex. Evidently some part of the elementary magnetic moment has become immobile in the crystal. The explanation offered for this is based on Stoner's theory of the magnetic properties of the ions of the first transition group of the periodic table, and is essentially that in this case the orbits of the electrons involved are held rigidly by the fields of near-by atoms, whilst the spin moments of the electrons are unaffected and can orientate in the applied magnetic field. Prof. Bose had already produced a closely similar immobilisation in ions of cobalt, nickel, and iron by changing these into complex forms, and it is now found that this also involves a shift of the absorption bands of their spectra towards the ultra-violet. This is attributed to the necessity for overcoming the orbital coupling forces within the complex when the electron jump associated with the absorption takes place, and it is shown that an extension of these ideas will account for the changes in the absorption spectra of both cerium and gadolinium ions which have been observed by Freed on cooling certain substances which contain them. Further evidence for the nature of the coupling forces which immobilise part of the ion is contained in a second letter received from Prof. Bose and Mr. Datta, in

which they outline a possible correlation between some new bands which they have observed in the ultra-violet absorption spectrum of the ion  $\text{Ce}^{+++}$  in solution and some of the lines in the ultra-violet emission spectrum of the same ion which were measured and classified by Badami last year. An explanation is offered, based upon the nature of the terms involved, of why the difference between their and Badami's wave-lengths is sometimes positive and sometimes negative.

**Sensitive Flames**—Whilst the behaviour of the sensitive flame is still imperfectly understood, a number of interesting experiments on the subject have been described by G. B. Brown (*Phil Mag*, Jan 1932). The best jet diameters lie between 0.5 mm and 5 mm, and the flame is always most sensitive to sound when it is on the point of 'flaring'. The position and construction of the tube supplying gas to the jet affects the sensitivity only in so far as it can alter the way in which the gas streams out of the orifice. The sound frequencies producing maximum or minimum disturbance are definite constants for any particular gas, no matter what kind of jet is used. The range of frequency to which gaseous streams are sensitive varies with the gas used and with the size and nature of the jet. With air the range is quite low (80-900), with unlit gas somewhat higher, and with ignited coal gas or hydrogen the range extends with different jets from 500 to more than 18,000 vib per sec. For a regular circular orifice the velocity for sensitiveness is high for a high-frequency range and low for a low-frequency range. It appears that sound does not, as has been generally assumed, precipitate the state of turbulence into which the gas stream is about to fall, but it causes regular undulations to proceed from the jet up the column,

the upper part of the column breaking into turbulence. The wave-length of these undulations depends, as would be expected, on the velocity of the column and the frequency of the sound. The most sensitive flames have marked directional properties.

**Discs and Conical Diaphragms in Sound Reproduction**—The use of conical diaphragms in the design of modern loud-speakers has stimulated interest in their behaviour from the physical point of view. In a recent paper by Dr N. W. McLachlan (*Proc Phys Soc*, Jan 1932), the results of experimental methods have been developed which lead to the determination of the effective mass of vibrating discs and conical diaphragms. It is shown that the 'effective' mass of a circular aluminium disc vibrating in air is variable. In the centre-stationary mode the effective mass attains a positive maximum before the zero value and a negative maximum after it. From the shape of the curves for a disc, it is possible to interpret those obtained for conical diaphragms. In the latter case the curves depend on the angle of the apex of the cone. When the apex angle is  $160^\circ$  the disc characteristics are still apparent. As the angle is reduced the properties peculiar to a conical diaphragm assert themselves. When the angle is nearly zero, the characteristics of a cylinder become apparent. The expression 'nodal circle' is sometimes used in connexion with conical diaphragms, but the actual lines of minimum amplitude traced by the lycopodium powder were quite irregular and occasionally discontinuous. The shape of the diaphragm during vibration is determined partly by (a) transmission loss, (b) acoustic load, and (c) reactive load due to accession to inertia. When impedance measurements are made in air and *in vacuo*, it is seen that (b) and (c) are absent in the second case.

### Astronomical Topics

**Application of Sound Films to Timing Solar Eclipses**—The Annual Report of Mount Wilson Observatory for the year 1930-31 refers to an ingenious method of obtaining the exact time and duration of totality in the very brief total eclipse of April 28, 1930. The Mount Wilson party was stationed at Honey Lake, California, which is at lat  $40^\circ 8' 20''$  N, long  $120^\circ 15' 30''$  W, altitude 4000 feet. Moving pictures with sound records were taken by the Fox Movietone News. The observers gave audible time signals about the time of totality, which were recorded in conjunction with the film showing the progress of the eclipse. The time of mid-totality was thus recorded as 19<sup>h</sup> 5<sup>m</sup> 51<sup>s</sup> U.T., which was 1<sup>s</sup> 7<sup>th</sup> earlier than the prediction, the duration of totality was recorded as 1<sup>m</sup> 2<sup>s</sup>, which was 0<sup>m</sup> 2<sup>s</sup> less than the prediction. It is worth noting that totality could frequently be timed in this manner, even if the weather is cloudy. At Colwyn Bay in 1927 the sky was densely overcast, but the passage of the moon's shadow on the clouds at the beginning and end of totality was plainly visible. As the seconds of Greenwich time were audible, distributed by wireless from Daventry, such a record would have enabled the times to be deduced at least to the nearest second.

**Another Search for Intra-Mercurial Planets**—Searches made in former eclipses have made the existence of intra-Mercurial planets very improbable. But the plates taken by Prof. Freundlich's expedition to north Sumatra in 1929 were so rich in stars that Herr von Klüber, of Potsdam Observatory, thought it worth while to make an exhaustive search for such bodies: the plates were compared with the control

ones taken six months later with the same instrument. The search established that there was no planetary body as bright as magnitude 9.5 in the regions of the plates that were more than  $40'$  from the sun's limb. The brightness of the corona obscured faint stars nearer the sun, but even in this region a body of magnitude 7 could have been detected. The search was worth making, and strengthens the conclusion that there is no body of appreciable size inside the orbit of Mercury.

**A Tenth Trojan Planet**—The object detected by Herr Reimmuth on Dec. 31 was at first thought to be a comet, but the suspicion of nebulousity round it was not confirmed, and a new orbit of it is given by Dr Kahrstedt in *Rech. Inst. Circ.* 547, based on observations on Dec. 31, Jan. 12, Feb. 6:

|                           |           |
|---------------------------|-----------|
| Epoch 1932 Jan. 17 0 U.T. |           |
| <i>M</i>                  | 305 0058° |
| $\omega$                  | 87 0034   |
| $\Omega$                  | 47 0466   |
| <i>i</i>                  | 32 9207   |
| $\phi$                    | 2 1893    |
| <i>n</i>                  | 294 549"  |
| log <i>a</i>              | 0.720566  |

There are now five known Trojans on each side of Jupiter, Achilles, Hector, Nestor, Agamemnon, Odysseus have longitude about  $60^\circ$  greater than Jupiter's, Patroclus, Priamus, Aeneas, Anchises, 1931 YA have longitude  $60^\circ$  less. If the names of Hector and Patroclus were interchanged, we should have Greeks on one side and Trojans on the other.

## Medical Research in Great Britain

FEW people can do more than glance through the majority of the scientific periodicals, reserving their attention solely for papers which deal with the subjects in which they are particularly interested. For those who wish to keep abreast of the times in medical science, perusal of the Report of the Medical Research Council\* is a convenient means of obtaining a review of recent work carried out in Great Britain. For those who desire fuller information on any subject, the lists of papers published by investigators working under the auspices of the Council will afford a starting-point.

As in previous years, the facilities of the Council have been increased by additions to its funds from various public bodies and private benefactors, by gifts of material from manufacturing firms, and by the fact that more than half of the work sponsored by the Council is carried out by investigators in university laboratories, where the general facilities of the laboratory are at their disposal. Particular investigations have been aided by the Empire Marketing Board, the Dental Board of the United Kingdom, the British Empire Cancer Campaign, the Distemper Research Council of the *Field*, and the Foot-and-Mouth Disease Research Committee. The material supplied by different firms has permitted extensive investigation into the control of dental decay, puerperal fever, and other infections by dietetic means, as well as facilitating the search for pure vitamin D, to mention only two examples.

The two senior members of the Council, Prof. T. R. Elliott and Prof. J. B. Leathes, retired at the close of the year under review, their places being taken by Lord Dawson of Penn and Prof. E. Mellanby. It is also noted in the Report that a Committee of the Privy Council for Agricultural Research and an Agricultural Research Council have now been appointed. With their formation the full triad of research organisations under the Privy Council is now completed. They deal together with the three main departments of man's activities with material things: the Agricultural Research Council with the production and protection of plant and animal life needed for human use, the Department of Scientific and Industrial Research with the materials and methods used in all forms of manufacturing industry, and the Medical Research Council with the proper development and use of the human body in all conditions, as well as with its protection from disease and accident and its repair.

The Medical Research Council awarded eight travelling Rockefeller medical fellowships and two Dorothy Temple Cross research fellowships in tuberculosis for the academic year 1931-32. During the past year the publication of a "System of Bacteriology" in nine volumes was completed and financial aid has been brought to *Nutrition Abstracts and Reviews*, in which the Imperial Agricultural Bureaux Council and the Reid Library of the Rowett Institute, Aberdeen, are also interested.

This year's Report reprints in an appendix the Council's memorandum on patent law in relation to medical research, which was submitted for consideration by the Departmental Committee on the Patents and Designs Acts and Practice of the Patent Office, 1929-31, since the Council does not believe that the questions at issue in the case of medical patents can long await renewed attempt towards their solution. The objections to the operation of the Patent Law in the field of biology and medicine are three in number:

First, the discovery of new facts in the medical field may lead, obviously and at once, without any intervening steps of ingenious invention, to valuable practical uses; discovery and invention cannot be clearly distinguished as in the inorganic field. Secondly, biological discoveries in their first phases are necessarily in the form of vague knowledge, and patents are likely to be drawn in wide terms that really go beyond the knowledge of the moment, for example, the Steenbock patent, controlling the commercial production of vitamin D by a natural process, covered the production of a substance of undetermined composition from an unknown constituent of certain complex materials by an action not then understood. It is now claimed to cover the production of calciferol or pure vitamin D from pure ergosterol, knowledge which is of more recent date and of independent origin. In the third place, medical discoverers in Great Britain rarely take out patents, so that the law works capriciously in favour of the few who break the tradition, or of the foreigner. The Council recommends that medical discoveries should not be patentable.

The National Institute for Medical Research carried out much work in connexion with biological standards, especially in preparation for the meeting of the Permanent Commission on Biological Standards (Health Organisation of the League of Nations) held in London at the end of June, which dealt with sera and bacterial products and the vitamins. Standards for gas gangrene antitoxin, diphtheria toxin for the Schick test, and for vitamins A, B<sub>1</sub>, C, and D were adopted at this conference. Gas gangrene antitoxin has now been scheduled under the Therapeutic Substances Act. The National Institute is also preparing the standards for vitamins A and D, carotene and an oily solution of irradiated ergosterol respectively, and is acting as the distributing centre for these as well as for the standard for vitamin B<sub>1</sub>, a dried adsorption product, on fuller's earth, of the active constituent of rice polishings, supplied by Prof. Jansen. The Institute already holds the international standards for insulin, digitalis, strophanthidin, and certain organic arsenical preparations. In addition, it prepares and maintains for Great Britain all the standard preparations required for substances scheduled under the Therapeutic Substances Act.

During the year the Council formed the Therapeutic Trials Committee, under the supervision and authority of which clinical trials of new substances may be organised. Conditions have been made with the Association of British Chemical Manufacturers under which new substances will be accepted for clinical study. It is also expected that other committees of the Council, such as the Chemotherapy and Sex Hormones Committees, will bring forward new synthetic compounds or biological products for early clinical appraisal under controlled conditions.

Brief reference must be made to some of the researches carried out by members of the staff of the National Institute and by other investigators on the Council's staff or provided with grants-in-aid. W. J. Elford has prepared a series of graded collodion membranes of which the pores have a uniform and measurable size and yet are sufficiently strong for bacteriological work. By means of these filters it has been possible to determine the size of the particles of a number of different viruses. Thus the diameter of the vaccinia virus ranges from 0.125  $\mu$  to 0.175  $\mu$ , that of infectious ectromelia of mice from 0.1  $\mu$  to 0.15  $\mu$ , that of a bacteriophage from 0.02  $\mu$  to 0.08  $\mu$ , whilst that of foot-and-mouth disease is of the minute size of 0.008-0.012  $\mu$ . The size of the virus particles of

\* Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the year 1930-1931. (Cmd. 4008) Pp. 153 (London: H.M. Stationery Office, 1932.) 2s. 6d. net.

infectious ectromelia agrees with that found by J E Barnard by the methods of ultra-microscopy

The vaccine-virus method for the immunisation of dogs against distemper is now firmly established and its value has been amply demonstrated. It will be possible to bring the research work to an end in the near future. The difficulties in the commercial production of this preparation have now been overcome. Inquiry of masters of foxhounds has shown that the incidence of infection among immunised animals is only 1.4 per cent and the mortality 0.3 per cent, whereas without inoculation the incidence among young foxhounds is nearly a hundred per cent and the mortality is frequently 50 per cent and may be 75 per cent. G W Dunkin and P P Laidlaw have also succeeded in preparing a hyper-immune serum which can be used in the incubation period of the disease or in its treatment, as well as in the production of immunity by injection simultaneously with the virus.

W E Gye and W J Purdy have continued their work on the viruses of avian tumours and have published their results in "The Cause of Cancer" (1931). In the sera obtained after injecting tumour filtrates containing the active agents into other animals, two kinds of antibodies were detected, one directed against a factor in the infective agent which is specific to the cells of the host, and the others adapted to an extrinsic factor of this agent. The viruses from most of the fowl tumours are serologically identical, but

Fujinami's fowl tumour, which is also transmissible to the duck, yields a virus which is immunologically distinct from the others.

M Greenwood, W W C Topley, and J Wilson have continued their studies in experimental epidemiology. From a study of the virus disease, infectious ectromelia, in mice, it is concluded that herd immunisation in bacterial and virus infections may be fundamentally different. In mouse typhoid, an immunised group will withstand a period of acute exposure to risk better than untreated animals, but, provided the exposure is continued, the general effect on the herd will be relatively trivial. In the case of a virus disease, it is probable that if admission to an infected herd were restricted to immunised animals, the herd mortality might be completely arrested. Experience with human diseases, in which the immunity produced is antitoxic rather than antibacterial, suggests that such infections behave as virus rather than bacterial infections.

In conclusion, it may be mentioned that reference is made in the Report to the work of Bourdillon and his colleagues on the preparation of pure vitamin D, as well as to the work carried out on the relation between diet and dental disease, and diet and infantile anaemia, summaries of many of these researches have already appeared in our columns. Work has also been continued, under the direction of E Mellanby, on the relation of diet to certain types of nervous disease, as well as to goitre and puerperal infection.

### Science and Economic Values

IN a paper before the London Section of the Society of Chemical Industry on Feb 1, Mr H A F Lindsay, India Trade Commissioner, dealing with "Modern Trade Tendencies and where they are leading", referred to the pronounced tendency to shorten stocks and to place the main responsibility on the primary producer. The shorter stocks carried in the chain between producer and consumer and the closer contact between producer and consumer are responsible in large measure for the violent fluctuations of price which are so prominent a feature of the markets to-day. A return to the practice of stock-holding by intermediaries is not probable, and accordingly the contribution which science renders in speeding up and rendering more accurate and general the trade information available for the world's markets is an important factor in stability, if only as assisting the spread of the practice of long-term contracts.

Trade cannot be established on a really satisfactory basis until the prices of raw materials and manufactured goods are brought close together, and towards this scientific methods are assisting by gradually increasing the output of the primary producer—whether in quantity or quality or both—and thus increasing the profits of agriculture, by bringing down the price and improving the quality of manufactures, and by slowly reducing the costs of distribution and transport. A new order of retail selling in which retail prices are fixed by the manufacturer, allowing a sufficient margin for retail and other distribution costs, has the merit of being scientific, but low whole-

sale prices cannot induce increased demand unless the public secures the benefit of a fall in the wholesale prices of any given commodity.

Mr Lindsay further suggested that our economic relations, whether national or international, are losing much of their instinctive value and acquiring new and more conscious values. New principles which are checking the operation of the old 'laws' of supply and demand may prove to be better suited for the changed conditions of modern life, and the extent to which humanitarian factors now affect the level of wages may only be an example of the passing of instinctive into conscious control, in which the humanitarian and the economic aspects are finally reconciled.

So far as scientific discoveries tend to cheapen production and eliminate waste, by stimulating demand they simultaneously tend to encourage the factors the strength of which increases with every swing of the pendulum away from equilibrium. So far as synthetic products are concerned, science appears to be co-operating most closely with economics, and it is only in its quicker response to the transition from an ideal of competition to an ideal of co-operation that science can be said to have outstripped economics. The new ideal of efficiency attained by mankind working consciously, constructively, and in co-operation towards a common goal does not eliminate competition but subordinates it to constructive forces, among which science is pre-eminent, and which are more qualified to exert deliberate and conscious control.

### Mechanism of the Combustion of Methane

THIRTY years have elapsed since Profs W A Bone and R V Wheeler first studied the combustion of methane and were led to the view that oxidation takes place through successive stages of hydroxylation of the hydrocarbon. In view of suggestions made in recent years that the initial products

of combustion might be peroxides rather than hydroxides, the investigation has been resumed and some important results are embodied in two recent papers.<sup>1</sup> In the first of these, Prof Bone and Mr R E Allum describe the course of the reaction at atmospheric pressure, while in the second, Dr D M Newitt

and Mr A E Haffner discuss the effect of pressures, varying from 48 to 150 atmospheres, upon the same reaction

The low-pressure experiments were carried out in silica vessels, which could be heated in an electric furnace to about 450° C and suddenly chilled by immersion in ice water, so that the process could be arrested and the products analysed, while the high-pressure experiments were conducted in chambers of special steel, which could be made to communicate with an expansion chamber at any moment. Precautions were taken to dissipate the heat of reactions sufficiently to counteract any rise of temperature, by diluting the original gas mixtures with excess either of the hydrocarbon or of indifferent gases. Varying proportions of the reacting gases were used, and the effect of adding water vapour and other gases to the carefully purified and well-dried mixtures was also studied. The results are in complete agreement with the original view that oxidation proceeds by the process of hydroxylation.

In the first place, in these experiments, as in former investigations, it has been shown that the most reactive of all the mixtures is that expressed by the formula  $2\text{CH}_4 + \text{O}_2$ , which corresponds with the formation of methanol. Secondly, although there is a considerable deficiency of oxygen in this mixture for complete combustion of the hydrocarbon, neither free carbon nor free hydrogen was ever liberated, nor was any trace of a peroxide detected at any stage of the reaction. The most conclusive evidence, however, lies in the actual isolation and identification of the primary product, methanol, which under high pressure is formed in considerable amount. It was to be expected from stoichiometric relationships that increased pressure would favour the formation of the alcohol at the expense of the aldehyde, and the authors are to be congratulated on being able to show that this expectation has at last been realised.

It appears from these results that the effect of increasing the pressure is to increase not only the amounts of methanol and formaldehyde which survive, but also the ratio of alcohol to aldehyde. Moreover, for each pressure there is a definite temperature (not the lowest effective temperature) at which the yield of alcohol reaches a maximum. The alcohol was characterised by means of its *p*-nitrobenzoyl derivative, and the complete absence of peroxides was inferred from the failure of the titanous sulphate reaction, which is sensitive to two parts per million.

The oxidation is mainly a surface effect, characterised by a marked period of induction, which may be obliterated by the addition of certain vapours. The authors do not discuss the cause of this period of induction, but they state that the end of it synchronises with a certain small accumulation of formaldehyde, which persists throughout the reaction period.

<sup>1</sup> *Proc Roy Soc, A*, 134, 578, 591. See also *NATURE*, 127, 481, 128, 188.

### University and Educational Intelligence

APPLICATIONS are invited for grants from the Thomas Smythe Hughes Medical Research Fund of the University of London. They should reach the Academic Registrar, University of London, South Kensington, S W 7, not later than May 16.

THE latest date for the receipt of applications for grants from the Dixon Fund for the assistance of scientific investigations is May 14. The applications, accompanied by the names and addresses of two references, should be sent to the Academic Registrar, University of London, South Kensington, S W 7.

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OPTOMETRY, defined in the New York State law as "the employment of any means other than the use of drugs, for the measurement of the powers of vision and the adaptation of lenses for the aid thereof", offers opportunities of a career for which a four years university course is held to be a suitable preparation. A bulletin received from Columbia University, New York, describes in detail a curriculum analogous to other professional courses designed to occupy a student's entire time during four years, of which the first two include such fundamental subjects as English, German, contemporary civilisation, mathematics, physics, chemistry, physiology, etc., and the last two are devoted almost exclusively to professional studies bearing directly on the theory and practice of optometry. That these courses are held by qualified judges to be in fact a suitable preparation for practical work seems to be proved by the fact that during the past ten or twelve years optical societies, instrument makers, and others specially interested in the development of optical engineering or in training optometrists have contributed gifts of apparatus valued at 25-30 thousand dollars.

### Calendar of Geographical Exploration

April 10, 1627 — South Coast of Australia

The *Gulden Zeepard*, commanded by Francis Thyszoon, with Pieter Nuyts on board, arrived in Batavia, Java, after having in a single voyage discovered the whole south coast of Australia so far east as long 133°. The Pieter Nuyts Archipelago indicates the eastern limit which they reached, and the land north of the Great Australian Bight was long known as Pieter Nuyts Land.

April 15, 1928 — An Arctic Flight

Starting from Point Barrow, Alaska, Capt G H Wilkins and Lieut Eielson flew across the Arctic Ocean, reaching Spitsbergen in 20½ hours and covering 2200 miles. Wilkins was knighted on his return.

April 16, 1245 — A Papal Envoy to the Grand Khan

John de Plano Carpini, a Franciscan, set out on a mission from the Pope to the Grand Khan of the Mongols. He travelled via Ciacow and Kiev, went down the Dnieper, crossed the Don near its mouth, and reached the Volga about a hundred miles north of the modern Astrakhan. He then went across the Aral-Caspian depression to the Syr Daria, went past Lake Ala Kul, and arrived at the camp of the Mongols near Karakoram on July 22, 1246. He left a very accurate and detailed description of his journey, giving accounts of the climate and vegetation of the steppe and of the customs of the nomads. He described the drainage of South Russia, giving the Slavonic names of the rivers.

April 16, 1906 — Mountain Ascents by the Duke of the Abruzzi

Luigi Amadeo, Duke of the Abruzzi, left Naples for Mombasa on an expedition to Mt Ruwenzori. He was the first to reach its twin summits, which he named Margherita and Alexandra. His party made a detailed survey of the Ruwenzori Range. In 1897 he had been the first to ascend Mt St Elias in Alaska, and in 1899 he organised a polar expedition, which reached lat 86° 3' N, at that time a record. In 1909 he explored the Central Karakoram in the Himalayas, and achieved a record for height by climbing peak K2.



## Societies and Academies

## LONDON

Physical Society, Feb 5—R M Davies The rapid determination of the moisture-content of seeds Two new methods are described, the first involving the use of a thermionic oscillator, the second a direct-current galvanometer and a battery The first method is best suited for use with large-grained seed, whilst the second can be used with all types of seed—M C Johnson Surface heating by neutralised positive rays before and after return to normal state This is shown by investigating the disturbance of a bridge balance between two filaments accurately aligned across the beam at different distances along its path Excess heating occurs in that filament which receives the larger proportion of atoms in excited states The variation of this excess heating with the potential driving the discharge is quantitatively in agreement with the variation of concentration of excited atoms at the different distances along the beam this latter is calculated from Wien's experiments on the exponential decay of excited states along the path of neutralised positive rays—E V Appleton and F W Chapman The collisional friction experienced by vibrating electrons in ionised air The variation of the radio-frequency conductivity of ionised air with pressure has been studied experimentally at frequencies of the order of  $10^9$  From the measurements of the critical pressure at which such conductivity is a maximum, the magnitude of the collisional frictional forces experienced by vibrating electrons has been estimated

Geological Society, Feb 10—S James Shand The reaction between granitic magma and limestone at Palabora, Transvaal (lecture) The Palabora granite is intrusive among ancient schists which include bodies of crystalline limestone The hill Lulu Kop is a mass of metamorphosed dolomitic limestone isolated in the granite Between granite and limestone there is a belt of flat ground, within which all the rocks exposed are rich in diopside and apatite, they vary from shonkinite to pyroxenite and massive apatite Between these rocks and the granite there is a narrow belt of diopside-arfvedsonite-syenite The evidence indicates extensive reaction between granitic magma and limestone, producing syenite and shonkinite, and it is suggested that the pyroxenite was formed by the sinking of diopside crystals from the contaminated magma—S James Shand The lavas of Mauritius The lavas of Mauritius are mainly basalts, some rich in olivine and others almost or quite free from it No feldspaths have been detected, but some of the rocks are of the 'pacificite' type, having nepheline in the norm Soda-trachyte was found at two localities, and must be regarded as a differentiate of the basaltic magma

## DUBLIN

Royal Dublin Society, Feb 23—W S E Hickson and K C Bailey The inhibition of chemical reactions (5) The inhibition of the absorption of ethylene by sulphuric acid The surface tension of solutions of pyridine in sulphuric acid The absorption of ethylene by sulphuric acid is inhibited by pyridine and other substances The amount of inhibitor required is relatively large The inhibitors investigated raise the surface tension of sulphuric acid and are therefore present in low concentration at the liquid-gas interface, at or near which the main reaction takes place—James B Butler and Anne Humphries On the growth in artificial media of *Catenaria anguillula*, a chytridiacean fungus, parasitic on the ova of *Fasciola hepatica* Various com-

binations of agar, extract of fluke ova, and egg albumen gave positive results The fungus grew out from the infected ova, and formed an extensive thallus, containing in one instance upwards of sixty zoosporangia Germination of the zoospores in the artificial media was observed The zoospores developed profuse growths of hyphae, which advanced to the formation of zoosporangia The zoosporangia in their turn produced zoospores and dehiscence tubes—James B Butler—On a method of determining the depth of penetration of wood-boring beetles in structural timber A modified form of laryngoscope was shown which could conveniently be used for exploring the surface of a half-inch hole bored in the beam to be tested

## EDINBURGH

Royal Society of Edinburgh, Feb 1—Frederick Walker Differentiation in the sills of Northern Trotternish, Skye The sills intrusive into the Jurassic strata of Northern Trotternish represent the continuation north of the great group of basic sills described by Dr Harker They were, however, injected under a much thicker cover than the more southerly examples, and therefore show the effects of differentiation to a far greater extent Picrite-dolerite sills are very common, and teschenites are also to be found Gravitational settling of olivine *in situ* may be demonstrated in more than one sill, but the mode of differentiation in other cases is less certain—Gec. A Cumming A study of the San Andreas rift and adjacent features near Redlands, California The fault zone is composed of numerous interlacing faults tending roughly to parallel the master fault The fault planes are in general nearly vertical Horizontal shearing appears to be the dominant movement, but in this area there is also evidence of great vertical movements A major branch fault, the Mission Creek fault, is characterised by the presence of a narrow ribbon of steeply dipping Tertiary sediments, traceable for miles, faulted between immensely older gneisses—G W Tyrrell Contributions to the stratigraphy of the Stor Fjord region of Spitsbergen Numerous sections in the gently inclined Mesozoic rocks were described Fossil determinations show that the western coast of the Stor Fjord is composed mainly of Jurassic and Cretaceous rocks, while Barents and Edge Islands on the east are built of Triassic strata—G W Tyrrell and E S Sandford Tectonics and petrology of the dolerites of Spitsbergen A great dolerite sill-swarm of Lower Cretaceous age is distributed over 50,000 square miles of the Spitsbergen archipelago The petrography of the rocks, with two new analyses, is described, and their relations to the structural lines and tectonic history of Spitsbergen are elucidated.

## PARIS

Academy of Sciences, Feb 22—A Lacroix The intrusive and vein-containing rocks of the granitic and sedimentary region of the north of Tibesti—J Constantin Climatic degenerescence of the potato.—Armand de Gramont The factors of reflection and transmission of some metals deposited by cathode sputtering The results differ with the gas present deposits formed in argon are generally the best. Good mirrors can be deposited with tin, and this metal has the advantage that the films are less alterable in air than those of silver—Henri Lagatu, Louis Maume, and Mlle Lucienne Cros Study of the variations in the amounts of nitrogen in very localised points of the leaf of the vine—Theobald Smith was elected *Correspondant* for the Section of Rural Economy, and Jules Schokalsky *Correspondant* for the Section of Geography and Navigation—Miron

Nicolesco The problem of Riquier—S Samielevici Singular integral equations—Mariani Relativity and quanta—Edouard Callandreau A property of circular cylinders submitted to torsion—Ch Féry and N Stoyko The isochronism of a pendulum maintained by an impulse acting after the vertical—Al Proca A new characteristic of Dirac's electron—Louis de Broglie Remarks on the first integrals of wave mechanics—L Bouchet The influence of radioactive bodies on the Volta effect—R Forrer The law of discontinuous distribution of the Curie points—B Demetrovic The pseudo-reflection of the X-rays—Ion I Agarbiceanu The absorption spectrum of iodine—E Darmon and Yeu-Ki-Heng The influence of thorium salts on the rotatory power of tartaric acid and the tartrates Thorium forms complex compounds with tartrates The large rotations observed are due to the formation of true chemical compounds—J Cabannes and A Rousset Molecular symmetry and diffusion spectra—Mme Irène Curie and F Joliot The effect of absorption of  $\gamma$ -rays of very high frequency by projection of light nuclei—Morice Letort Five new oxidation-reduction indicators—E Cornec and H Krombach The equilibria between water, potassium chloride, and sodium chloride from  $-23^{\circ}\text{C}$  to  $+190^{\circ}\text{C}$ —Mlle O Hun Boiling point study of the molecular equilibria of pyrocatechol in solutions of calcium chloride and barium chloride—E Vellinger The rotatory power of some aminoacids as a function of the acidity (pH)—Lucien Andrieux The preparation of the mixed borides of thorium and cerium—L Bert and E Andor A new method of preparation of the  $\beta$ -chlorallyl bromide and iodide—Er Toporescu Studies on the inversion of sugar—Mme Ramart-Lucas The parallelism between colour and reactivity of a chromophore group—P Fleury and J Courtois The general character of the precipitation of sugars and the polyols by the hydroxides of the heavy metals in alkaline media—Mlle M Th François The acidity of castor oil The free fatty acids contained in castor oil are strongly retained by the neutral glycerides, and separation by physical methods appears to be impossible—Paul Gaubert Spherulites of helenine—J P Arend The genesis of ooliths—Raymond Furon New observations on the Cretaceous rocks of the Gabon coast—Mlle Lucienne George Observations on *Sorbus confusa* (= *S. aria* + *torminalis*)—J Trochain The biology of two Commelinaceae, *Commelina Forskaleri* and *C. benghalensis*—E Bachrach and G Morin A new (conditional) acquired reflex—Pierre Girard and Mme L Guastalla The electrophoresis of biological media—F Vlès and A de Coulon An intervention of electrostatic conditions in the appearance of certain spontaneous cancers

Feb 29—The president announced the death on Feb 28 of M G Bigourdan, of the Section of Astronomy, president of the Academy in 1924—A Lacroix The composition of the orthose lavas of the Tibesti volcanoes—Paul Pascal and Mme Rechid The hexametaphosphates A description of the preparation and properties of a new sodium hexametaphosphate,  $\text{Na}_6(\text{PO}_3)_6 \cdot 10\text{H}_2\text{O}$  This salt is regarded as a definite individual, and resembles the monometaphosphate in that it can be heated to any temperature without undergoing modification—Pierre de Vanssay was elected *Correspondant* for the Section of Geography and Navigation—Claude Chevalley The structure of the theory of the body of classes—D Belorizky The nature of the impacts in the problem of three bodies with three degrees of freedom—Thadée Banachiewicz The determination of the orbit from two heliocentric

points—L Goldstein The multiple excitation of complex atoms by impacts with electrons—A Guillet An electro-dynamical arrangement for the measurement of small mutual inductances Application to the examination of micrometers—R Forrer Verifications of the law of discontinuous distribution of the Curie points—R Ricard The first spark spectrum of mercury—Paul Soleillet The mean duration of life of the cadmium atom in the excited states  $^3P_1$  and  $^1P_1$ —E Cornec and H Krombach A physical method for the determination of potassium chloride in sylvinites The method is based on the fall of temperature resulting from the addition of potassium chloride to a saturated solution of sodium chloride Comparisons between results obtained by this method and the usual perchlorate method are given—Louis Chassevent Anhydrite and its formation An explanation of the apparent contradiction between the results of van't Hoff and those of Jolibois and Lefebvre—V Auger and Mme Poulenc-Ferrand Cupric carbonate Normal copper carbonate ( $\text{CuCO}_3$ ) has not yet been prepared, and it appears improbable that it can be prepared by a wet method—J Marçais The Cretaceous and the Nummulitic in the eastern Rif—Antonin Lanquine The accidents of the western edge of the Jurassic *Barres* between Belgentier and Néoules (Var)—P Fallot The extension towards the south-east of the marginal overlapping of the limestone chain of the Spanish Rif—Mlle M Goldsmith The proportion of the sexes in *Galleria melonella* While under normal conditions of temperature and diet the two sexes occur in practically equal numbers, if the food is insufficient, males predominate (17 per cent females)—P Durand and J Laigret Pustular fever (fièvre boutonneuse) and 'Marseilles fever' Crossed immunity A first attack of fièvre boutonneuse of Tunisian origin confers complete immunity against another Tunisian virus Similarly, a first attack due to a virus of Marseilles origin confers immunity against a Tunisian virus

#### ROME

Royal National Academy of the Lincei, Nov 1—S Pincherle A special linear operator (3)—Luisa Pelosi Maximum and minimum chords normal to a hypersurface By somewhat complicated calculation Bonnet determined (in 1843) the normal to a given ellipse (or parabola) for which the chord within the curve is a minimum, and found that such chord is tangential to the evolute of the ellipse at the point where it meets the ellipse It is now shown that this result is capable of generalisation, and that if a chord normal to a hypersurface is such that the segment of it contained in the hypersurface is a maximum or a minimum (without being binormal to the surface), this segment is equal to one of the principal radii of curvature of the hypersurface—B Hostinsky Integration of linear functional transformations (2)—A Quarleri Theory of the 'wake' in perfect liquids case of the round cylinder—G Lampariello Waves of discontinuity in the more general elastic media The existence in the most general elastic medium of three possible waves is established, the direction of propagation of each of them being determinable by constructing the corresponding bicharacteristics—A Corbellini and L Barbaro Abnormal decomposition of the tetrazo-derivative of 2,2'-diamino-1,1'-dinaphthyl The acidic compound formed as a result of this decomposition is, most probably, [4,5-(naphtho-1',2')-pyrazolyl (3)]-orthocinnamic acid—G Mezzadrol and E Vareton Contribution to the study of the photosynthesis of glucides in ultra-violet light from aqueous solutions of activated carbon dioxide The formation of formaldehyde, glycollic aldehyde,

and reducing sugars on exposure of carbon dioxide solution to the action of ultra-violet rays is greatly enhanced by the presence in the solution of colloidal calcium or magnesium carbonate—G Zanoni. Certain correlation phenomena in plants. Experiments with *Solanum pseudocapsicum* and *Jasminum lucidum* show that the action of light on leaves exposed to it modifies the transparent green colour according to a kind of cyclic curve during the twenty-four hours of the day. With this local action, there corresponds a diffusion of the reaction, by which the leaves of the branches kept in the dark exhibit, more or less rapidly, the colour changes of the leaves subject to direct illumination—L Buccianto. Survival of embryonic tissues of the hen kept in Ringer's solution at low temperatures. The permanence of embryonic tissues of the hen in Ringer's solution at 5°-10° C permits of the protracted survival of the elements of the tissues, but varies markedly in degree for different tissues. This phenomenon is probably accompanied by progressive subtraction of trophic substances, which diffuse from the cells into the liquid. Indeed, the addition of embryo juice is an almost indispensable condition for the cultivation of tissues in Ringer's solution, in a culture medium of plasma alone, the tissues either fail to grow or grow only to a very slight extent—Aldo Spirito. Experiments on grafting with the edible frog (3)—O Marcucci. Grafting experiments with amphibia—Giulio Cotronei and Celso Guareschi. Zoological constitution and grafting (8). Experiments with Anura and Urodeles—A Galamini. Course of fasting and re-nutrition in ovariectomised albino rats (1). The phenomena observed with these rats during fasting and during subsequent feeding are substantially the same as with the normal rats—A Galamini and E Serianni. Modifications of glucosuria and hydremia resulting from the administration of glucose and water—Giuseppe Levi. Obituary notice of Albert Brachet.

## VIENNA

Academy of Sciences, Dec 3—N Froschl, A Maier, and A Heuberger. The catalytic reduction of chlorides of dibasic acids—N Froschl and J Harlass. The preparation of naphthalene-dicarboxylic acid—N Froschl and A Heuberger. The acetalisation of polyvalent alcohols with mono- and di-ketones—N Froschl and J Harlass. Attempts at the synthetic preparation of agaricic acid—J. Zellner. The chemistry of lichens (1) *Peltigera canina*—J. Zellner. The chemistry of halophytes (3) *Sueda salsa*—C G Danoff and J Zellner. Contributions to comparative plant chemistry. Chemistry of barks. Various substances in the barks of mountain ash and edible chestnut—F Feigl and P Krumholz. The action of alkali alcoholates on iron pentacarbonyl. Salts of iron, barium and mercury can be obtained corresponding to a hydrogen iron carbonyl—L Schmid and L Haschek. Cryoscopic determination of the molecular weights of sugars and of mulin in liquid ammonia—K Grafi. Photometric observations of the Milky Way and of the zodiacal light in Majorca—T Pintner. The little-known and unknown as regards tapeworms—E Tschermak. Artificial illumination as a stimulus in hot-houses. For plant-breeders and scientific genetics it is becoming worth while to use cheap electric current in conjunction with gaseous carbon dioxide, especially in the winter months. In this way two generations can be raised indoors and a third in the open during one year, also artificial cross-fertilisations succeed indoors in winter—Y. Lebzelter. The anthropology of the No-gau bushmen on the lower Omuramba Epukiro in South-West Africa. Measurements are given. The No-gau are allied to the Kung.

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## Forthcoming Events

## FRIDAY, APRIL 8

- ROYAL SOCIETY OF ARTS (Indian Meeting), at 4 30—Sir Richard Burn. Recent Developments in Land Revenue and Rent Policy in the United Provinces.  
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Royal Victoria Hotel, Sheffield), at 6—T G Elliot and Dr W Cullen. Special Alloy Steels as applied to Chemical Engineering.  
INSTITUTE OF FUEL (East Midlands Section) (Annual General Meeting) (at University College, Nottingham), at 7—V B Harley-Mason. Conditioning of Boiler Feed Water.  
SOCIETY OF DYERS AND COLOURISTS (Scottish Section) (Annual General Meeting) (at George Hotel, Glasgow), at 7 15—J Muir. Some Notes on pH Control by Colorimetric Methods (with demonstrations).  
OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at College of Technology, Manchester)—Annual Meeting.

## APRIL 8 TO 11

- CONGRESS OF GERMAN PHARMACOLOGICAL SOCIETY (at Wiesbaden).

## MONDAY, APRIL 11

- ROYAL SOCIETY OF MEDICINE (United Services Section) (Annual General Meeting), at 4 30—Surg-Commr W H Edgar. Scarlet Fever: an Effort in Preventive Medicine.

## APRIL 11 TO 14

- CONGRESS OF GERMAN SOCIETY FOR INTERNAL MEDICINE (at Wiesbaden).

## TUESDAY, APRIL 12

- INSTITUTE OF ELECTRICAL ENGINEERS (Scottish Centre) (Annual General Meeting) (at 39 Elmbank Crescent, Glasgow), at 7 30—W B Hird and J B Mavor. Electrically Driven Underground Conveyors in Coal Mines, and their Economic Advantages.  
INSTITUTE OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7 30—Annual General Meeting.

## WEDNESDAY, APRIL 13

- INSTITUTE OF FUEL (London Section) (Annual General Meeting) (at Chemical Society), at 6—Dr E S Grumell. Evaluation of Coal from the Users' Standpoint.  
ROYAL SOCIETY OF ARTS, at 8—J R I Brooke. Rural Industries: their Organisation and Development (Lecture).

## THURSDAY, APRIL 14

- INSTITUTE OF METALS (London Local Section) (Annual General Meeting) (at 83 Pall Mall), at 7 30—Discussion on Welding, Brazing, and Soldering.

## FRIDAY, APRIL 15

- SOCIETY FOR EXPERIMENTAL BIOLOGY (in Department of Zoology, University Museums, Oxford), at 10 30 A M, 2 30, and 5 30.  
ROYAL ANTHROPOLOGICAL INSTITUTE (Sociological Research Committee), at 2—J H Driberg. Economic Stages of Development in Africa.  
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at 36 George Street, Manchester), at 7—Annual Meeting.

## SATURDAY, APRIL 16

- SOCIETY FOR EXPERIMENTAL BIOLOGY (in Department of Zoology, University Museums, Oxford), at 10 A M and 2 30.

## Official Publications Received

## BRITISH

- Union of South Africa. Department of Mines and Industries. Geological Survey. The Geology of the Country south of Piet Retief, in Explanation of Sheet No 58 (Piet Retief). By Dr W A Humphrey and Dr L J Krige. Pp 72. (Pretoria Government Printing Office) 5s, including Map.  
Memoirs of the Geological Survey of India. Vol 57. Coal in India. 1. The Natural History of Indian Coal. By Dr Cyril S Fox. Pp vii+283+xxv+17 plates. (Calcutta Government of India Central Publication Branch) 9 4 rupees 15s 6d.

- Union of South Africa Department of Agriculture Science Bulletin 100 Bunchy Top Disease of Tomato By A P D McLean Pp 28+8 plates (Pretoria Government Printing Office) 3d
- Annual Report of the Indian Central Cotton Committee, Bombay, for the Year ending 31st August 1931 Pp ii+119 (Bombay G Claridge and Co., Ltd.) 2 rupees
- Memoirs of the Indian Meteorological Department Vol 25, Part 8 The Lunar Atmospheric Tide at Bombay (1873-1922) By Dr S K Pramanik Pp iv+279 289 (Calcutta Government of India Central Publication Branch) 10 annas, 1s
- The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol. 70, No 423, March Pp 297-392+xiv (London E and F N Spon, Ltd) 10s 6d
- Proceedings of the Malacological Society of London Edited by R Winckworth Vol 20, Part 1, March Pp 76+8 plates (London Dulau and Co., Ltd) 10s net
- City of Birmingham Education Committee The Value of Vocational Tests as aids to Choice of Employment Report of Research by E Patricia Allen and Percival Smith Pp vi+68 (Birmingham Education Committee) 1s net
- The Indian Forest Records Entomology Series, Vol 16, Part 10 New Species of *Exocentrus* Mulsant from India (Coleoptera Cerambycidae Subfamily Lamiinae) By W S Fisher Pp ii+31 (Calcutta Government of India Central Publication Branch) 7 annas, 9d
- Proceedings of the Nova Scotian Institute of Science Vol 18, 1930-1931, Part 1 Pp 21 (Halifax, N S)
- Archeologische Navorsing van die Nasionale Museum, Bloemfontein Deel 1, Stuk 2 4 2, Die Koningse Kultuur, n Die Verspreiding van die Koningse Industrie, deur Dr Ir E C N Van Hoepen, 3, Die Suid-Afrikaanse Klipwerktuie in Internasionale Verband, deur Dr Ir E C N Van Hoepen, 4, Die Mosselbaase Kultuur, deur Dr Ir E C N Van Hoepen Pp 13 54+plates 5-19 (Bloemfontein)
- Empire Marketing Board Preliminary Report on the Vitamin Content of the Mango By Edith O V Perry and Dr S S Zilva Pp 24 (London H M Stationery Office) 1s net
- Ministry of Health Advisory Committee on Nutrition Memorandum to the Minister of Health on The Criticism and Improvement of Diets Pp 14 3d net Report to the Minister of Health on Diets in Poor Law Children's Homes Pp 17 3d net (London H M Stationery Office)
- Department of Scientific and Industrial Research Building Science Abstracts Vol 5 (New Series), No 2, February Abstracts Nos 189 388 Pp 37 72 (London H M Stationery Office) 1s net
- Sight and Sound a Quarterly Review of Modern Aids to Learning Published under the Auspices of the British Institute of Adult Education Vol 1, No 1 Pp 30+xx (London British Institute of Adult Education) 1s
- Report of the Marlborough College Natural History Society for the Year ending Christmas, 1931 (No 80) Pp 81+4 plates (Marlborough)
- India Meteorological Department Scientific Notes Vol 4, No 3 A Study of the Structure of the Bay Storm of November 1926 By Dr Sobhag Mal and Dr B N Desai Pp 87-100+13 plates 2 2 rupees, 4s Vol 4, No 4 The Katabatic Winds of Poona By S Atmanathan Pp 101 115+2 plates 1 rupee, 1s 9d Vol 4, No 42 A Discussion of Monthly Mean Values of Upper Air Temperatures and Humidities obtained from Aeroplane Ascents at Peshawar and Quetta By A Narayanan Pp 125 136+3 plates 10 annas, 1s (Calcutta Government of India Central Publication Branch)

## FOREIGN

- Department of Agriculture, Straits Settlements and Federated Malay States Scientific Series, No 9 Hydnocarpus Oils in Malaya By C D V Georgi, Dr T A Buckley and Gunn Lay Teik Pp 18 (Kuala Lumpur) 50 cents
- Bernice P Bishop Museum Bulletin 83 New Plants from Fiji, II By John Wynn Gillespie Pp 72+1 plate Bulletin 84 Flora of Southeastern Polynesia 1 Monocotyledons By Forest B H Brown (Bayard Dominick Expedition, Publication No 20) Pp 194+35 plates Bulletin 85 The Land Snail Genus *Carelia* By C Montague Cooke, Jr Pp 97+18 plates Bulletin 86 Flora of Rarotonga By Gerrit Parmile Wilder Pp 113+8 plates Bulletin 87 Distribution and Variability of Ceratium in the Northern and Western Pacific By Anton Bohm Pp 46+1 plate Bulletin 88 Population and Utilization of Land and Sea in Hawaii, 1853 By John Wesley Coulter Pp 33 Bulletin 89 Flora of Southeastern Polynesia 2 Pteridophytes By Elizabeth D W Brown and Forest B H Brown (Bayard Dominick Expedition, Publication No 21) Pp 123+21 plates Bulletin 90 Houses, Boats and Fishing in the Society Islands By E S Craghill Handy Pp 111+25 plates Bulletin 91 New Plants from Fiji, II By John Wynn Gillespie Pp 81 (Honolulu, Hawaii)
- Memoirs of the Bernice P Bishop Museum Vol 11, No 5 The Fishes of Oceania, Supplement 1 By Henry W Fowler Pp 71 (Honolulu, Hawaii)
- Bernice P Bishop Museum Occasional Papers Vol 9, No 14 Additions to the Flora of Niuhau By Harold St John Pp 11 Vol 9, No 15 Geology of the Pacific Equatorial Islands By Chester K Wentworth (Whippoorwill Expedition Publication No 3) Pp 25 Vol 9, No 16 Mosses of Raiatea By Edwin B Bartram Pp 14 Vol 9, No 17 New Crustaceans from Kauai, Oahu and Maui By Charles Howard Edmondson Pp 18 (Honolulu, Hawaii)
- Bulletin of the National Research Council No 84 Report of the Committee on Hydrodynamics, Division of Physical Sciences, National Research Council Pp ii+634 4 50 dollars No 86 Bibliography of Bibliographies on Chemistry and Chemical Technology Second Supplement 1929-1931 Compiled by Clarence J West and D D Berolzheimer Pp 150 1 50 dollars (Washington, D C National Academy of Sciences)
- Smithsonian Institution United States National Museum Bulletin 157 The Butterflies of the District of Columbia and Vicinity By Austin H Clark Pp vii+337+64 plates (Washington, D C Government Printing Office)
- Physikalische Zeitschrift der Sowjetunion Herausgegeben vom Obersten Volkswirtschaftsrat der UdSSR Band 1, Heft 1 Pp 188 (Karkow) 15 rubel per year

- Proceedings of the California Academy of Sciences, Fourth Series Vol 20, No 9 Miscellaneous Studies in the Elateridae and related Families of Coleoptera By Edwin C Van Dyke Pp 291-465 (San Francisco) 1 dollar
- State of Illinois Department of Registration and Education Division of the Natural History Survey Bulletin, Vol 19, Article 5 The Plankton of the Sangamon River in the Summer of 1929 By Samuel Eddy Pp ii+469 485 Bulletin, Vol 19, Article 6 An Experimental and Observational Study of the Chumch Bug in relation to Climate and Weather By V E Shelford Pp iii+457-547 (Urbana, Ill)
- Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 84 A Jamaican Fluvialite Nerita By Henry A Pilsbry Pp 11 14 The Land Snail Genus *Polygyrella* By Henry A Pilsbry Pp 15 19 (Philadelphia)
- Division of Fish and Game of California Fish Bulletin No 35 A Distributional List of the Species of Freshwater Fishes known to occur in California By Dr Barton Warren Evermann and Howard Walton Clark Pp 87 Fish Bulletin No 36 A Bibliography of the Sardines By Genevieve Corwin Wheeler (Contribution No 111 from the California State Fisheries Laboratory) Pp 135 (Terminal, Calif California State Fisheries Laboratory)
- Proceedings of the Imperial Academy Vol 8, No 1, January Pp 26 (Tokyo)
- Sveriges Geologiska Undersökning Ser Aa, No 172 Beskrivning till kartbladet Lugnas Av G Lundqvist, A Hogbom och A H Westergård Pp 185+1 tavl 4 00 kr Ser C, No 372 Diplocraterion, Monocraterion and Scolithus from the Lower Cambrian of Sweden By A H Westergård Pp 25+10 plates 2 00 kr (Stockholm P A Norstedt and Soner)
- Proceedings of the American Philosophical Society Vol 71, No 1 Pp 38 (Philadelphia)
- U S Department of the Interior Office of Education Bulletin, 1931, No 20 Biennial Survey of Education in the United States, 1928-1930 Chapter 6 Homemaking Education By Emeline S Whitcomb Pp 34 10 cents Pamphlet No 24 Salaries in Land Grant Universities and Colleges By John H McNeely Pp ii+27 5 cents (Washington, D C Government Printing Office)
- Agricultural Experiment Station of the Rhode Island State College Bulletin 233 Etiological Studies of Blackhead (Enterohepatitis) in Turkeys By John P Delaplane Pp 15 (Kingston, R I)
- Collection des travaux chimiques de Tchecoslovaquie Rédigée et publiée par E Votobek et J Heyrovský Année 4, No 2, Février Pp 49 96 (Prague Regia Societas Scientiarum Bohemica)
- Results of the Meteorological Observations in Työsen for the Lustrum, 1926-1930 Pp vi+56 (Zinsen Meteorological Observatory)
- Proceedings of the United States National Museum Vol 79, Art 29 The Buffalo Motive in Middle Celebes Decorative Design By Walter Hough (No 2895) Pp 8+9 plates Vol 79, Art 32 Excavations at a Prehistoric Indian Village Site in Mississippi By Henry B Collins, Jr (No 2898) Pp 32+13 plates Vol 80, Art 6 The Fishes obtained by the Pinchot South Seas Expedition of 1929, with Description of one New Genus and three New Species By Henry W Fowler (No 2908) Pp 16 Vol 80, Art 12 The Birds of St Lawrence Island, Bering Sea By Herbert Friedmann (No 2912) Pp 31+6 plates (Washington, D C Government Printing Office)
- Regenwaarnemingen in Nederlandsch-Indië Twee en vijftigste Jaargang, 1930 Pp ii+139 (Batavia Landsdrukkerij)
- Bulletin of the Geological Institution of the University of Upsala Vol 23 Pp iii+337+12 plates (Upsala Almqvist and Wiksels Boktryckeri A B)
- Memorias del Consejo Oceanográfico Iberoamericano Numero 6 Las posibilidades de un futuro desarrollo de la pesquera maritima en Chile Por Dr Hans Lubbert Pp 19 Numero 7 El volcanismo oceanico abismal Por J Thoulet (Madrid)
- Meddelelser om Grönland udgivne af Kommissionen for Videnskabelige Undersøgelser i Grönland Bd 79, Nr 1 The Godthaab Expedition 1928 Hydroids By P L Kramp Pp 86 Bd 91, Nr 3 Hydroids collected in West Greenland Fjords in 1911 and 1912 By P L Kramp Pp 35 (København C A Reitzels Forlag)
- University of California Publications in Archaeology and Ethnology Vol 29, No 4 The Patwin and their Neighbors By A L Kroeber Pp v+253 428 (Berkeley, Calif University of California Press) 1 60 dollars
- U S Department of the Interior Office of Education Bulletin, 1931, No 20 Biennial Survey of Education in the United States, 1928-1930 Chapter 5 Statistics of Teachers Colleges and Normal Schools, 1929-1930 Pp 78 15 cents Bulletin, 1931, No 20 Biennial Survey of Education in the United States, 1928-1930 Chapter 7 Statistics of Private High Schools and Academies, 1929-30 Pp 49 10 cents (Washington, D C Government Printing Office)
- Smithsonian Institution United States National Museum Bulletin 156 Aboriginal Indian Pottery of the Dominican Republic By Herbert W Krieger Pp iii+165+56 plates (Washington, D C Government Printing Office) 75 cents
- A Preliminary Study of the Ruins of Cobá, Quintana Roo, Mexico By J Eric Thompson, Harry E D Pollock, Jean Charlot (Publication No 424) Pp vii+213+18 plates (Washington, D C Carnegie Institution)
- Scientific Survey of Porto Rico and the Virgin Islands Vol 12, Part 1. Insects of Porto Rico and the Virgin Islands Heterocera or Moths (excepting the Noctuidae, Geometridae and Pyralidae) By W T M Forbes Pp 173+2 plates (New York New York Academy of Sciences)
- Smithsonian Miscellaneous Collections Vol 85, No 7 Effectiveness in Nature of the so called Protective Adaptations in the Animal Kingdom, chiefly as illustrated by the Food Habits of Nearctic Birds By W L McAtee (Publication 3125) Pp 201 (Washington, D C Smithsonian Institution)
- The Physical Laboratories of Harvard University Pp 47 (Cambridge, Mass)

## CATALOGUES

- Hair Hygrometers Pp 2 (London Negretti and Zambra)
- Floodlights on Photography Pp 16 (London Burroughs Wellcome and Co)



SATURDAY, APRIL 16, 1932

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## Scientific Aspects of Fiscal Policy

IN a pamphlet entitled "The State and Industry in 1932", printed for private circulation, Capt Harold Macmillan, M P, elaborates further the scientific policy which should be the natural accompaniment of the British Government's general tariff plan and the creation of the Import Duties Advisory Committee (see NATURE, Feb 20, 1932, p 271). Capt Macmillan directs attention to the positive aspects of this new departure in fiscal policy, to the administrative problems which it presents, and to the vital importance that the opportunities under the new policy of securing the development of our industries on deliberately planned lines should be wisely, efficiently, and expeditiously used. The administrative methods adopted make the Import Duties Advisory Committee the keystone of the structure, and upon its efficient functioning depends the success of the whole policy. Altogether apart from the abilities of those chosen for this work, there is serious danger that the Committee may become a bottle-neck rather than an efficient clearing-house, resulting in delays exasperating to the applicants and endangering precariously situated industries, or in ill-considered judgments which will later bring discredit upon the Committee and upon the policy it is endeavouring to apply.

The execution of a constructive policy which is to be prospective and not merely retrospective involves the consideration by the Committee of many involved and highly technical problems on which it will require expert advice, and Capt Macmillan proceeds to discuss the methods by which such expert advice can be obtained from representatives of industry before blockage occurs and irreparable damage to public confidence has been done. In doing so, Capt Macmillan stresses the complexity of the economic problems involved and the high degree of social co-ordination required for their solution.

Scientific advance and large-scale production have so knit the nation into a compact unit that almost every question is now a national question and every action taken has its repercussions through the whole economic structure. While the field of Government responsibility is constantly increasing with every effort to deal with the acute problems arising out of changes in the balance and technique of production throughout the world, the close relation of those problems to industry involves increasing dangers from bureaucratic methods. Capt Macmillan sees in the existence of a National Government an opportunity of reviewing the whole

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situation and avoiding a drift into future difficulties, by inquiring into the whole agenda of government and, if necessary, providing new machinery

To enable the Committee to exercise a guiding hand in the wider problems of reconstruction and to liberate it from detailed consideration of separate applications for additional duties, and at the same time to preserve industrial self-government, Capt Macmillan suggests as the necessary liaison with industry a representative Department of Industry or an industrial sub-parliament consisting of two or three representatives from national councils for industries or groups of industries. These representatives would be available for consultation by the Import Duties Advisory Committee in its efforts to reconcile the interests of producing and consuming industries where protective measures were under discussion, following the precedent of the Dyestuffs (Import Regulation) Act, and, if unsuccessful in reaching a satisfactory agreement, would enable the necessary information to be collected and the Committee to reach a rapid decision

This 'sub-parliament' would consider questions for the adequate discussion of which there is no present provision, including the displacement of labour through rationalisation, the balance of national production in the light of home requirements and export possibilities, the possibilities for the expansion of certain industries and provision for contraction of others, the conditions required for the development of new industries suitable to the country, the distribution of employment and its relation to housing, transport, road, water, gas, and electricity facilities, the gap between producers' and consumers' prices, the variation in wage rates between productive industries and sheltered services, the closer co-ordination of British financial organisation and British industry, the complementary development of British Empire production, the protection of any one industry from the high costs of inefficiency in another

These proposals, which thus envisage the co-ordination of national activity in the general interests of trade and industry, are rightly regarded as involving a functional system of representation, and on this ground alone would merit the attention of scientific workers. Although some skeleton organisation already exists in the Federation of British Industries and the Association of British Chemical Manufacturers, etc., which covers the ground to a limited extent for the chief industries of Great Britain, other industries are less effectively organised for the expression of representative views

The plea for the scientific examination of these

difficult questions, for the substitution of decisions based on ascertained facts instead of opinions which may or may not be prejudiced, and, above all, for the evolution of a definite plan on national lines to which sectional interests are subordinate, must command the sympathy of all scientific workers. Their support and help will be demanded in many ways if answers are to be found to the intricate technical and scientific questions involved, and if the evolution of a planned economy involves to some extent a transition to functional representation in parliament, it will undoubtedly indicate simultaneously ways in which the knowledge and training of the scientific expert can be more efficiently placed at the service of the community for the solution of the innumerable social, economic, political, and industrial problems in which vital scientific factors are involved.

### Social Economics

*The Work, Wealth and Happiness of Mankind.*

By H G Wells Pp xiii + 850 + 32 plates  
(London William Heinemann, Ltd, 1932)  
10s 6d net.

MR WELLS writes of himself "He is attempting a book, a survey of the world, a scheme and map of *doing*, which will enable him to say to anyone whatever 'This is the whole world of work and wealth, of making and getting and spending, and here at this point is your place, and this is where you come in. . . .'" Seeking Mr Wells's place in his own scheme, we find that he claims for his book the function of transmitting, correlating, and interpreting for the general mind the essential living thought of the world. In his "Outline of History" and "Science of Life" he attempted this task for history and for biology, now it is the turn of economics and sociology. Mr Wells holds that mankind's ideology, or system of ideas about life in general, has become dangerously out of date, and out of correspondence with the realities of human affairs, since the "change of scale", the "abolition of distance", of the last few decades. He regards as essential for a modern ideology some understanding of world history (as against local, national, and period history), some assimilation of biological ideas, and—most urgently necessary of all—some conception of economic life, industrial processes, trade, and finance. Valiantly he has attempted to supply all three sides of this ideological triangle, and his third compendium, like its forerunners, is a remarkable, stimulating, valuable, and most readable book.



In the development of a modern ideology, the first step, says Mr Wells, is to learn to think. "Most of us do not think enough about thinking" Children and primitive peoples do a large part of their thinking by imagination, their thinking is a spontaneous, uncontrolled flow of images, with which impulses to act are connected. There is no critical element, and scarcely any use of generalisations or abstract ideas. Things not themselves physically real are apprehended in a symbolical and often a personified form. The thinking of many adults is still of this kind, corresponding to what has been called the 'mythological' phase of human development. This was followed by the gradual appearance of exacter discrimination, the mythological passed insensibly into the metaphorical, abstraction became possible, classification and examination of ideas began, and 'logical' thinking followed.

"This change from a mental life that was merely experience-checked imagining to an analytical mental life aiming at new and better knowledge and leading on to planned and directed effort, is still in progress. Over a large range of his interests man has still to acquire the habit of thinking with self-control and precision." "The man who orders his knowledge and thinks things out is as far above the natural man of impulse and traditional usage as the latter is above an ape which has not even tradition but only instinct."

Logical thinking, however, contains in itself a pitfall. Are words as true as material facts, or truer, or less true? If they are truer, then a logical conclusion is truer than an experience, and that, on the whole, was the 'Realist' assumption of classical and medieval times, the view that classes or Platonic ideas were the only reality, the view which nowadays is sometimes loosely called 'Idealism'. Realism was opposed by the 'Nominalist', for whom an experience is truer than a word. The defeat of philosophical Realism over large areas of human interest in the late Middle Ages and after was a necessary preliminary to the release of experimental science, and to the material triumphs following on the application of the scientific method of 'trying back to facts' all the time.

"The discovery of Evolution, the realisation, that is to say, that there are no strict limits set to animal and vegetable species, opened the whole world of life and its destiny to Nominalist thinking. The realisation by the world of mathematical physics that the universe can be represented as a four-dimensional universe of unique events has abolished the conception of a quantitative equivalence of cause and effect and made every atom unique."

The detachment of logical thinking from the Realist predispositions of the human mind remains, however, incomplete, and in the world of international politics the Realist way of thinking holds almost undisputed sway and lies at the root of the greatest dangers that threaten our race.

"Plainly a man who takes the Nominalist way and regards such a word as 'France' as merely covering a great area of country, climatic and social associations, and about forty million human beings of very diverse kinds (numbers of them not even speaking French) will regard international politics from an entirely different angle from a Realist who finds in the word France something more real and vital than any single individual or thing that contributes to the ensemble of that idea. The Nominalist and Realist of contemporary life, all unaware of this difference in the very elements of their thought, find each the other stupefyingly obtuse. The Realist 'patriot' calls his brother Nominalist 'traitor' or 'cosmopolitan scoundrel', and the like, and is amazed that he does not wince; the Nominalist humanitarian calls the Realist, obdurate dogmatist or romanticist, and accuses him of a perverse taste for contention and blood."

Mr Wells, then, would have mankind abandon emotional for logical thinking, and in logical thinking beware of 'Realist' assumptions and remember the fruitfulness of the scientific appeal to fact. His early chapters recite some of the practical triumphs of science, the conquest of materials—iron and steel, rubber, petroleum, dyes, drugs, cellulose—the conquest of power, the organisation of transport, the transmission of facts, the application of artificial fertilisers and mechanical methods to agriculture, all the modern developments in the feeding and clothing and housing of mankind. He discusses the ways in which work is organised, and then turns aside to inquire why people work. He divides mankind into three classes, according to their guiding idea of themselves, or "persona": the "peasant", characterised by the idea that toil is virtue, and by intense acquisitiveness, the "aggressive nomad", generous, reckless, and rapacious, and the "educated" man, originally priestly in function, who works not for his own enrichment, or for his own honour and glory, but is devoted to some end transcending personal considerations. With the peasant type and derived from it, Mr Wells places the peasant-minded townsman, giving rise on one hand to a crop of "petty" and "big bourgeois", and on the other to a multitude of "expropriated" proletarians who have lost their grip upon property.

The peasant persona and its modifications will tend to cause the possessor to work for personal

gain, the nomad persona for personal glory, the educated persona for some ideal of service. Mr Wells denies the Individualist creed that the peasant-craving for tangible property generally is a fundamental incentive to work. "The human animal wants a feeling of security and it wants freedom and the feeling of power. These wants are truly fundamental." The experience of the educated types shows, he thinks, that the satisfaction of these desires can be guaranteed in quite other ways than by the actual possession of land, wife, children, goods, and chattels. With the extension of literacy, the mentality of the learned clerk begins to penetrate everywhere, carrying its traditional disposition to find the satisfaction of good achievement greater than the satisfaction of possessions. The search for security, comfort, and liberty becomes the ruling motive in keeping mankind busy.

Mr Wells pauses to note a common confusion between independence and liberty. "Independence is no doubt being abolished in the case of individuals just as in the case of sovereign states, but independence is not freedom. An 'independent' peasant or small tradesman is tied, with scarcely a day's holiday, to his cultivation or his shop." But the worker under modern conditions has real personal freedom in the way of daily leisure, holidays, choice of activities and purchases. To provide such modern satisfactions, and to free himself from tangible burdensome ownership, man has made use of the abstraction of a monetary system. Mr Wells discusses currency, financial methods, banking, and investment, and gives an account of the world depression with the monetary factors well emphasised. He describes recent proposals for monetary reform, indicating here, as in many other parts of the book, the imperative need for international action.

The closing chapters bring him again to education, and to his reiterated thesis that a civilised World State can only develop in correlation with the spread of the 'educated' persona, with the replacement of the motives of profit and privilege by the motive of service in affairs of every kind. Such a co-operative outlook has become essential, nothing less than world planning for political and economic change can avert disaster. Mr Wells is optimistic enough to believe in the necessary educability of mankind, for is not educability the main distinguishing characteristic of *Homo sapiens*?

If "The Work, Wealth and Happiness of Mankind" is not on the whole as satisfactory as the "Outline of History" or the "Science of Life",

the defect is probably inherent in the less developed state of economic science as compared with history or biology, and perhaps also in our more primitive type of thought on economic subjects. One misses those diagrams and tables which were so useful a feature of the two earlier books, and which are replaced by a few casually selected photographs in the present volume. Yet Mr Wells has given us what is likely to remain for a long time the most comprehensive and lucid account available of the tangled complexity of economic processes in their human aspect, and the ways in which those processes are affected by the decisions we all have to make.

### A Survey of Radioactivity

*Lehrbuch der Radioaktivität* Von Georg v. Hevesy und Fritz Paneth. Zweite, völlig umgearbeitete Auflage. Pp. xii + 287. (Leipzig: Johann Ambrosius Barth, 1931.)

THIS book was first published in 1923 and immediately found an appreciative public on the Continent. It became more widely known to British and American readers in 1926 when it was brought up to date and translated. That edition was reviewed in these pages at the time (see NATURE for Oct. 2, 1926, p. 475).

The work has now been thoroughly rewritten, revised, and enlarged to embrace the more important advances made in the subject since 1923. It takes new matter forms about a quarter of the present book. It deals with such subjects as the radioactivity of potassium and rubidium, the 'packing effect', the structure of the nucleus, the distribution of electrons in atoms, the origin of the actinium series, and the interpretation of the facts of radioactivity on the new quantum mechanics.

The data of radioactivity have been brought up to date and given accurately. In one or two cases where constants have different values from those given in "Radiations from Radioactive Substances", they are those approved by the International Radium Standard Committee, the report of which appeared recently. They give the half-value period of the potassium isotope of mass 41 as  $7.5 \times 10^{11}$  years on the assumption, indicated by the experimental work of the senior author, that this mass is responsible for all the  $\beta$ -particles emitted. They follow Lord Rutherford and Dr. F. W. Aston in deriving the actinium series from a uranium isotope of mass 235. This is, of course, the right thing to do at present, since there is little or no doubt that the series ends on the mass actinium-D,

207, but a series of products, the masses of some of which are of odd number, may not have the simplicity of the thorium and radium series, where the only massive particle expelled is the  $\alpha$ -particle. There is a possibility that another massive particle is expelled. The final work of Dr F W Aston on the complexity of uranium should be an important contribution to this interesting problem. In the tables of isotopes and elements the new isotopes of carbon, nitrogen, and oxygen found by American workers are included, but nothing is said about elements 61, 85, and 87, except that they are still undiscovered.

This new edition has had the great advantage of being revised after the publication of the authoritative work of Lord Rutherford, J Chadwick, and C D Ellis. Its authors have succeeded in making it an informative, critical, and accurate textbook, covering not only the physical side of the subject with its many topics, but also the chemical and geological sides. It is wider in scope than the larger and more learned treatises. It is clearly written, and the text gains much from the fifty figures and nearly fifty tables which accompany it. It should be on the shelves of every physicist and inorganic chemist reading German who wishes a general, as opposed to a highly specialised, knowledge of this interesting range of subjects.

A S R

### The Migratory Impulse of Birds

*The Riddle of Migration* By William Rowan  
Pp xiv + 151 (Baltimore, Md. The Williams  
and Wilkins Co., London. Baillière, Tindall  
and Cox, 1931) 11s 6d net

THE author of this book is professor of zoology in the University of Alberta and he has most courageously undertaken the experimental study of the causes of the migration of birds. Some most astounding facts—experimental and observational—are recorded in his book. Edmonton, the city in which the University is situated, has wonderful advantages for this study. The tremendous contrast between the seasons in Canada compels practically all the birds to migrate. The minimum temperature in winter may drop to  $-52^{\circ}\text{F}$ , whilst the summer temperature may rise to  $100^{\circ}$ . Then to the north an unbroken plain stretches to the shores of the Arctic Ocean, whilst to the south-east a similar plain reaches the Gulf of Mexico, so that the physical obstacles to migration are slight.

Preliminary observations had suggested to

Prof Rowan the theory that the impulse to migration might arise from the swelling genital organs, and accordingly he selected a common native bird, the junco sparrow, as the subject of his experiments. This bird has about the size and appearance of the ordinary British sparrow, but it is at once distinguished from our sparrow by the white colour of its under-side and of the outer tail-feathers. A number of juncos were confined in a large cage and subjected to the influence of a powerful electric light for periods approximating to the length of a summer day until the winter solstice, whilst an equal number of controls in another cage experienced the gradually decreasing hours of daylight. Both cages were unheated. The gonads of the controls shrunk in size until at Christmas time they were mere shrivelled rudiments, whilst those of the illuminated birds grew in size and by January had attained almost their maximum development. Further, whilst the control birds remained inactive and were silent, the illuminated birds were in full song in the middle of winter.

The mode of action of the light was next considered. Was its action direct or did it act by keeping the bird in a high state of vitality? The answer to this question was found by keeping two sets of juncos in practical darkness, broken only by the glimmer of electric 'night-lights'. In one cage the controls were kept, whilst in the other an ingenious arrangement of moving perches was installed so that the birds had to keep hopping up and down. These birds developed large gonads in spite of the darkness and the cold.

We may say that this result of Prof Rowan's is confirmed by the experience of poultry-breeders in eastern Canada. 'Christmas eggs' were notoriously difficult to obtain in Canada, and their price used to reach fantastic heights. The old practice was to keep the birds in closed hutches heated by oil lamps. They became comatose in winter and refused to lay. Then the experiment was made of keeping them in hutches sheltered above but open below to the ingress of fresh air, and entirely unheated. The grain given as food was mixed with bran and sawdust, so that the birds had to kick and scratch vigorously to find it. These birds continued to lay eggs all through the winter.

It is therefore established that the impulse to migrate northward in the spring is called forth by swelling gonads. But how do the birds find their way over such enormous distances? According to the author, the Pacific plover annually migrates from British Columbia to Hawaii over two thousand

miles of sea, the golden plovers winter in Mexico and Central America, and when, after finishing their breeding, they return to their winter homes, the adults go through the eastern States and even over the sea, whilst the young leave after the adults and fly directly south through the central plains

Only two plausible explanations of migration have ever been put forward (1) that it is due to tradition and memory, (2) that it is the result of inherited habit Prof Rowan suggests that quite possibly the first explanation will hold for the movement of the older birds, since there is a rich harvest of autumn berries to be found on the east coast, but only the second will avail to account for the migration of the young birds, since they have never been south before Prof. Rowan pathetically remarks that this second explanation has a dangerous resemblance to Lamarckism, and that although no one has disproved Lamarckism, yet all the most elaborate experiments designed to test Lamarckism have given a negative result

Prof Rowan may take heart the elaborate experiments referred to—presumably Weismann's attempts to show that the mutilation of the tail is not inherited in mice, Brown-Sequard's assertion that epilepsy in mice induced by spinal section was transferred to offspring, etc—were planned to prove something which Lamarck himself would have utterly repudiated Lamarck says, "But whatever environment may do, it does not work any direct modification in the shape and organisation of animals, but great alterations in the environment of animals lead to great alterations in their needs, and these alterations in their needs lead to others in their activities Now if the new needs become permanent, the animals adopt new *habits* which last as long as the needs which evoked them All these are preserved by reproduction to the new individuals which arise" An 'acquired character', therefore, according to Lamarck, is an acquired habit, and if Prof. Rowan will look into the matter he will find that there is abundant experimental evidence for the effect of acquired habits on the next generation—not in the sense that the young retain in full force a habit acquired by the parent in a different environment, but that the young exhibit a trace of the parental habit, a trace which can be strengthened by constant repetition

Prof. Rowan is at present engaged in testing whether his birds forced into sexual maturity during the winter will migrate if released, and, if so, in what direction. The control of this experiment

is obviously extremely difficult, owing to the wide field open to the migrants and the difficulty of recapturing the migrants At the time of writing his book little progress had been made, but we understand that since that time Prof Rowan has had more success, and we look forward with interest to the appearance of a second edition of his book

E W MACBRIDE

### Psychic Sounds

*On the Edge of the Etheric being an Investigation of Psychic Phenomena based on a series of Sitzings with Mr John C Sloan, the Glasgow Trance and Direct Voice Medium* By J Arthur Findlay. Fifth impression Pp 177 (London Rider and Co, 1932) 3s 6d net

THIS volume, which has reached its fifth impression in four months, is the record of a series of sittings with a Scottish 'direct-voice' medium The author, who during his residence in Glasgow was a well-known business man, was fortunate in having secured a considerable number of sittings with this medium—an ordinary working man, by name John C Sloan—who is said to possess the most marvellous powers Not only is he clairvoyant and clairaudient, whatever these terms may mean, but also in his presence, and generally in darkness, voices are heard which purport to be those of deceased persons, voices which are recognised by their friends and relatives still alive, and give striking evidence of identity

Mr Findlay is of opinion that Mr Sloan is certainly not normally responsible for these voices, and he has come to the conclusion that they are what they purport to be, the spirits borrowing material wherewith to form some kind of materialised 'mask' in the likeness of a mouth and throat with which they make intelligible sounds This borrowed substance is alleged to be taken from the medium and sitters, and is then manipulated by the unseen entities for the purpose for which it is intended Although Mr Findlay claims to be interested in physics, and therefore, presumably, in scientific work, he appears to have made no experiments to test this remarkable phenomenon, concentrating his attention upon the evidence given by the voices in support of their claims, and, even more oddly, upon the information vouchsafed by the spirits regarding their surroundings Much of this material seems clearly derived from popular manuals dealing with the supposed 'etheric' body, and a good deal of it is directly traceable to spiritualistic literature having a wide circulation

The book is typical of many that are being published to-day. No one can deny that the phenomena, as they are described, are puzzling, and, if independent examination confirmed the account here printed, are worthy of the closest scientific scrutiny. But from reading Mr Findlay's records, the scientific method might be thought not to exist. He seems to have no appreciation of the implications underlying many of his remarks, no desire to see the phenomena described in accurate and scientific terminology. The explanations given by the spirits (who include, it may be added, Huxley, Faraday, and Wallace) are just what would be expected from a man who had read the works of Lodge, Crawford, and Schrenck-Notzing, and had combined scraps of each for his purposes. As explanations, they are worthless. As suggestive of human origins, they are significant.

### Short Reviews

(1) *International Address Book of Botanists being a Directory of Individuals and Scientific Institutions, Universities, Societies, etc., in all parts of the World interested in the Study of Botany*. Prepared in accordance with a Resolution passed at the Fifth International Botanical Congress, Cambridge, 1930. Published for the Bentham Trustees. Pp xv + 605. (London: Baillière, Tindall and Cox, 1931.) 12s 6d net.

(2) *A Biographical Index of deceased British and Irish Botanists*. Compiled by James Britten and George S. Boulger. Second edition, revised and completed by Dr A. B. Rendle. Pp xxii + 342. (London: Taylor and Francis, 1931.) n.p.

(1) At the Fifth International Botanical Congress held at Cambridge in 1930, the necessity for a new address book of botanists of the world was emphasised and an International Committee was appointed to make all arrangements for the publication of such a book. The Committee consisted of Prof L. Diels (Berlin), Dr E. D. Merrill (New York) and Major T. F. Chipp (London). After Major Chipp's untimely death in 1931, his share of the work was carried on by Miss M. Verbrugge. This volume is the result of the splendid effort of the Committee. Realising that it would be impossible to incorporate all available information in a compact volume of useful size, the compilers have made a wise choice of material and given such facts as they decided would be most sought after.

The arrangement is by countries alphabetically. The entries in each country include botanical societies, institutions (wholly or chiefly botanical), educational institutions having botanical departments, and an alphabetical list of professional and amateur botanists with their offices, qualifications, addresses, and special botanical interests.

It is certain that this book will prove invaluable to botanists throughout the world.

(2) Though the title would scarcely suggest it,

this book has proved very useful to botanists in the past, thus calling for a second edition. The compilers have been liberal in their choice of names to be included in the list, though nothing is redundant. The names are arranged alphabetically and are followed by dates of birth and death (in most cases place of burial has been omitted in the second edition), position and occupation, titles and degrees, dates of election to the Linnean and Royal Societies, reference to botanical work, portraits, and genus or species dedicated to the person in question.

The information, brought together in 342 pages, should be of great use to botanists in general, and especially to British botanists.

*A Handbook of the British Seaweeds*. By Prof. Lily Newton. Pp xiii + 478. (London: British Museum (Natural History), 1931.)

In order to fill the gap in botanical literature left by the absence of any up-to-date account of the British seaweeds, Dr A. B. Rendle, formerly keeper of the Department of Botany of the British Museum, arranged with Dr L. Batten, now Prof. Newton, to prepare this handbook. The basis of the arrangement is the "Catalogue of the British Marine Algae", by E. A. L. Batters, which has long been out of print. In all, about 260 genera and 750 species are described. The drawings were mostly made by the late Mr Percy Highley, though some are by Prof. Newton. The aid of members of the staff of the Department of Botany of the British Museum is freely acknowledged, thanks being especially due to Mr G. Tandy for his help on the taxonomy and nomenclature. This very useful book starts with an account of methods of collection, preservation, and of the distribution and ecological relationships of algae. An outline of the classification is given, also some data on economic uses. It may be remarked that the account of the preparation of iodine from kelp sounds like a translation from the German, and, according to the construction of the English, is incorrect.

The book should prove a great stimulus to the further study of this branch of botany, which has been neglected in Great Britain so long. Those who studied this branch of botany a few years ago cannot help being somewhat puzzled by the numerous changes in names, thus even our old friend *Fucus platycarpus* has disappeared and is not even mentioned as a synonym. The work appears to have been carried out with the care which one would expect, considering its origin. The illustrations have been well done, and the whole book can be heartily recommended.

*Handbook of Protozoology*. By Prof. R. R. Kudo. Pp vii + 451. (London: Baillière, Tindall and Cox, 1931.) 25s net.

NUMEROUS excellent textbooks of protozoology have already been published and at first sight it might seem that to add another to the list was superfluous, yet, as the author of the present one points out, most of the modern publications emphasise the parasitic forms and do not give much space to the

taxonomy and biology of the free living forms, from which the parasitic groups were undoubtedly derived

The book is divided into two parts, the first consisting of chapters devoted to the general morphology of Protozoa and, though briefly treated, gives the student a good elementary knowledge of the principles of protozoan structure and physiology. The second and more important section of the book is concerned with the taxonomy and general biology of the different groups of common Protozoa. This is probably the more useful section of the work, for, owing to the numerous comprehensive and widely scattered monographs that have appeared on the different groups, it is often difficult for the average student to obtain all the necessary literature.

The author, by gathering together in a limited space as much of such material as possible from various authorities, has rendered good service, and the book should prove valuable to teachers in universities—but perhaps more particularly to those engaged in applied biological science who are cut off from libraries but desire to identify the organisms found in their several fields of research.

*Die Insektenfauna des Bottlinger Marmors eine systematische und palaobiologische Studie* Von Dr Friedrich Zeuner (Fortschritte der Geologie und Palaontologie, herausgegeben von Prof Dr W Soergel, Band 9, Heft 28) Pp viii + 247-406 + 19 Tafeln (Berlin: Gebrüder Borntraeger, 1931) 25 gold marks

THE Bottlinger marble fills a fissure 10 metres wide and 400 metres long at the margin of a crater of Upper Miocene age near Munsingen in Swabia. In Upper Miocene times hot carbonated waters flowed up the fissure and deposited calcareous sinter within it. A varied insect life abounded in the bushes and grasses surrounding the well. Individuals of this fauna, venturing too near the fatal waters, were killed, their bodies fell into the well and were quickly encrusted with sinter. A swarm of bees was entombed in this manner. Thus was provided the beautiful material studied by Dr Zeuner, who gives a lively picture of conditions around this Upper Miocene poison hole.

Dr Zeuner describes in detail the insect fauna of this well, making four new genera and eleven new species. He discusses the phylogeny of the Upper Miocene insect faunas and the climate of the time. He concludes that the climate of separate periods of the Tertiary cannot be deduced independently from insect faunas, since many groups have changed their habitats since the Tertiary. Harrassowitz came to a similar conclusion in connexion with Tertiary floras.

*Physiography of Western United States* By Prof Nevin M Fenneman Pp xiii + 534 (New York: McGraw-Hill Book Co., Inc., London: McGraw-Hill Publishing Co., Ltd., 1931) 25s net

THE central theme of this book is geological rather than geographical. It treats land forms, which are its main concern, as effects and not as causes. Nevertheless, it will be of value to the geographer

as well as the geologist, for it gives accurate descriptions of the topography, with special stress on the drainage systems. The area covered lies approximately between long 100° W and the Pacific coast, and the treatment is by natural physical units called provinces and sections. These, as determined by the Association of American Geographers and United States Geological Survey, are shown on a large folding map which accompanies the volume. This useful map has also been separately published as an official American map.

The volume is clearly written and well arranged, though, of course, the treatment of different areas depends on the knowledge available. In a few parts little more than a description of the surface topography can be given. The many illustrations and block diagrams, and above all the copious bibliographical references, add to the value of the book. A companion volume on the Eastern United States is announced to be in hand.

*Botany for Matriculation* By Dr F Cavers Revised by L C Fox Second edition Pp viii + 509 (London: University Tutorial Press, Ltd., 1931) 6s 6d

To any candidate for university matriculation who is studying 'privately' with the view of matriculating only, and no ultimate aim of assuming an interest in, or attaining a sound knowledge of the science of botany, "*Botany for Matriculation*" is to be recommended. Such an opinion is offered to such 'private' students only, for we would prefer to leave the choice between a stimulating book and a 'cram' book to the teachers of other students.

The book begins, as it ends, with bald statements of fact and theory. It is profusely illustrated with diagrams fit to reproduce before an undiscerning examiner, but serving no other purpose. The subject matter has apparently been chosen to conform to the average matriculation syllabus. At the end of each chapter, a set of questions are given, in one case, the set of twenty-four questions contains sixteen which begin with the word 'Describe', and this is more or less the ratio throughout. L J F B

*Recent Advances in the Study of the Psychoneuroses.* By Dr Millais Culpin (The Recent Advances Series) Pp vii + 348 (London: J and A Churchill, 1931) 12s 6d

THE study of the psychoneuroses, or, as Dr Culpin sometimes prefers to call them, the minor psychoses, is a peculiarly wide and difficult subject. Dr Culpin in this book gives a very compact and readable account which well maintains the standard set in this series. The book is written from the point of view of psychoanalysis, that is, a strictly Freudian attitude. The views of Jung and Adler are well set out in separate chapters by Dr Young and Dr Redfern. Dr E Miller deals with the psychopathology of childhood and Dr Rees with psychotherapeutic clinics. While stressing the Freudian approach, the author is careful to maintain an even balance, so that the physical side of the picture is by no means neglected.



## Flame Movements in Gaseous Explosions

PROF. W. A. BONE and Mr. R. P. Fraser have recently described their further experiments upon detonation of combustible gaseous mixtures.\* Some very beautiful photographs of the phenomenon of 'spin', first observed by Campbell and Woodward (1926), have been taken by means of

explosive detonator. Ignition could also be brought about farther down the tube, either by a spark or by means of a detonator which provided a shock wave in nitrogen contained in the first part of the tube. Depending on the strength of the detonator, the shock wave could either be allowed to follow the explosion flame, to catch it up, to proceed with the same speed, or to pass through it: it was shown that in the latter case the shock wave could initiate flame in the gas mixture ahead of the flame front, as is shown in Fig. 1. The flame is here travelling in the direction left to right, and the photographic paper moving rapidly in the upward direction at right angles to the direction of the flame. The sudden acceleration of the flame when the com-

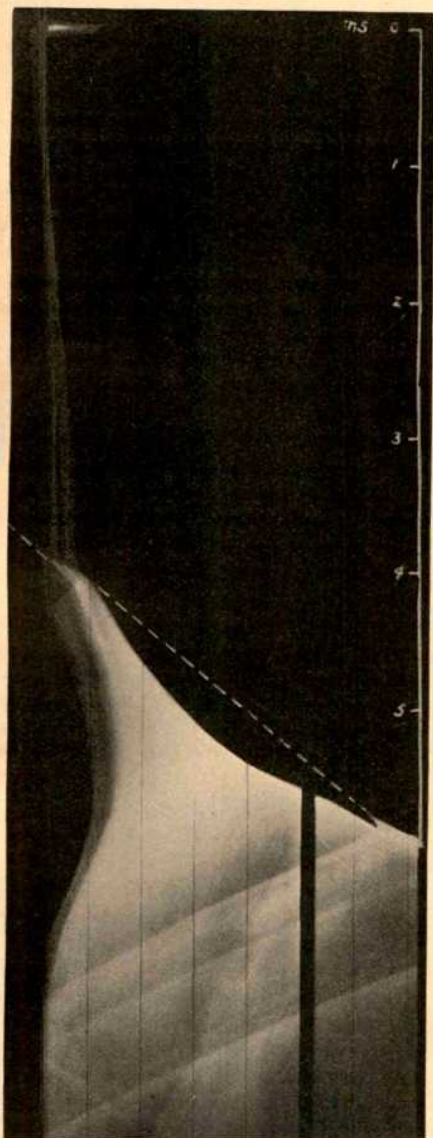


FIG. 1.—Compression wave (indicated by dotted line) overtaking advancing flame in 2CO : O<sub>2</sub> mixture.

the Fraser high speed camera, especially designed for this work, and described in *Phil. Trans.*, vol. 228, 1929, p. 197. The larger machine was able to provide a vertical peripheral film speed up to 200 metres per second, so that resolution of the high speed movements of the flame front is obtainable.

Explosion of the gas mixtures in the long glass tubes was initiated either by a spark or by a high

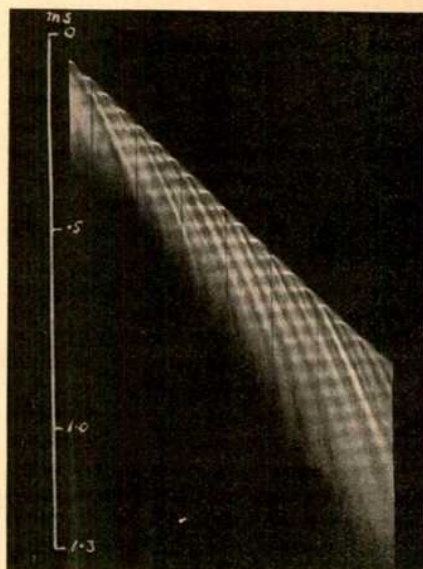


FIG. 2.—Spiral path of detonation in 2CO : O<sub>2</sub> mixture.

pression wave passes through it, and the subsequent ignition ahead of the compression wave prior to the arrival of the flame front, are clearly shown. The detonation wave can be seen travelling back through the burning gases, where the original flame front meets the auto-ignited flame. Impact of the shock wave on an advancing flame does not necessarily lead to detonation, but if the shock wave is sufficiently powerful, detonation is set up; it can even be caused to occur in this way close to the initiating spark. Prof. Bone and Mr. Fraser have confirmed that the velocity of the detonation wave during the early part of its course is more rapid than the subsequent uniform rate to which it settles down.

Part vi. of the paper deals with the phenomenon of spin already mentioned, which is well illustrated (Fig. 2). The flame does not appear to travel axially down the tube in the forward direction, but takes a spiral path: not only is this the case for the detonation wave, but also in some cases the phenomenon is observable in the advancing flame prior to detonation. Bands are visible in the gaseous

\* Photographic Investigation of Flame Movements in Gaseous Explosions, Parts iv., v., and vi., *Phil. Trans.*, vol. 230, p. 363.

products behind the flame, which have a frequency connected with the rotation of the 'head' of detonation—frequencies of more than 100,000 a second being sometimes observed. The distance traversed per second by the head of detonation along its spiral path is constant in a given gas mixture, and the ratio of pitch to the diameter of tube is nearly constant, but in some cases two or more rotating 'heads' of detonation are observable.

In the initial stages of an explosion the gaseous medium is moved forward along the direction of the tube axis: this forward impulsive motion would set up rotation about lines which may roughly be described as circles on a plane perpendicular to the axis and with centres approximately on it, and if

this were superposed on an axial rotation a spiral vortex system would be initiated. Whether an explanation on this basis can be derived, or whether the rapid agitation of molecules through the gaseous medium sets up a disturbance along the axis, changing to a spiral wave front or 'head' which in turn gives rise to periodic waves in the 'tail' behind, are matters which are to be the subject of further investigations. Thirty-four photographs which Prof. Bone and Mr. Fraser have presented in their paper afford very considerable food for thought, and no such remarkable records of the behaviour of rapid flame motion have been published since those in Prof. H. B. Dixon's memoir in the *Phil. Trans.* of 1903. A. C. E.

### Screen-Plate Colour Photography

THE two great lines of attack on the problem of colour photography are undoubtedly comprised in the 'subtractive' processes on one hand and the 'screen-plate' processes on the other. In spite of the initial simplicity of negative-making in the subtractive process and the application to three-colour work in commercial printing, the production of the following 'positive' colour pictures by the amateur is still a matter requiring some experience, skill, and patience. Although undoubted progress has been made, the results are not of a very certain character, and they are hard to control in any precise manner.

On the other hand, the 'screen-plate' processes are of a nature much more amenable to precise control. Their disadvantage, if it be a disadvantage, is that the immediate result is a transparency rather than a picture on paper; and the transparency cannot be seen to advantage without some care in its illumination or without the use of projection apparatus. We may, however, remark that the reason why so many amateurs nowadays are dissatisfied with their photographs is because the *viewing* of photographs has never received a tithe of the attention which has been so lavishly given to their taking. A small print made with a 4-inch lens is viewed from a distance of twelve or fifteen inches. The result is a false rendering of the perspective and a general impression of an insignificant little picture. If the same photograph is printed as a transparency and viewed under proper illumination with a lens of 4-inch focal length, the perspective is seen under the proper angle and the result is vastly more satisfying and impressive. The projection of the picture is an equally good alternative.

The present writer has tried in vain to convince manufacturers upon this point, but if those who produce colour transparencies take the matter to heart they are not likely to tire of their pictures, even those made on a very small scale. Properly viewed or projected, transparencies have a wealth of beauty and satisfaction to give as compared with the finest pictures on paper.

The well-known Autochrome and Agfa plates have the colour mosaic incorporated in the first

layer underneath the sensitive emulsion, and the positive picture is obtained by photographic 'reversal' of the negative obtained by exposure through the mosaic. The alternative procedure uses a colour screen printed separately on another plate of glass, the screen surface being held in contact with the emulsion of a panchromatic plate during the exposure. The negative resulting on development is printed as a positive and can then be bound up with a 'viewing screen' containing a corresponding mosaic; details are generally given in articles on colour photography. In this way, any number of copies can be made.

Examples of such processes were the Joly screen plate ruled in lines, and dating from 1904, and the plates developed by Mr. C. L. Finlay, which have been embodied in the 'Thames' and 'Paget' plates. The modern form is being marketed as the 'Finlay' process.

The progress made by photographic plate manufacturers has rendered possible corresponding progress in colour photography, since it is vitally dependent on satisfactory panchromatic emulsions. An Ilford panchromatic plate (700 H and D) is specially coated for the Finlay process, and a series of five carefully adjusted compensating filters is available for use with different conditions of natural and artificial lighting. The high speed of the plates allows of snapshot exposures under favourable lighting conditions if a lens working at an aperture of  $f/4.5$ , or thereabouts, is used.

The 'taking screen' with its mosaic of squares is printed by a secret process, but it is being claimed by the makers that a system of efficient inspection of the plates, and standardisation of the dyes, has enabled them to eliminate the variability which used to be experienced sometimes in the older types of plates. Methods of measurement of colour for microscopic objects are now easily available, and the efficient standardisation of the taking screens, filters, and viewing screens ought to be possible.

This is a matter of the very greatest importance for the technical use of the process in cases where pictorial colour records are required. The use of such records in microscopy, surgery, medical research, metallurgy, and other subjects would be



legion. It is impossible with a three-colour screen to make the photograph an absolutely exact rendering of the original visual impression, but it would be a great step to have a genuinely reproducible action, so that a definite colour difference occurring, say, in two photographs (taken at an interval) of a case of skin disease would have to be ascribed to an actual colour change in the object. This kind of reproducibility may be within the reach of really rigid standardisation, but this applies equally to the user's end of the business, where proper attention will be necessary in exposure, time and temperature of development and so on.

The use of a separate positive and viewing screen has now been superseded by the Finlay positive colour screen made by coating a viewing screen with a positive emulsion. Very careful registration is naturally necessary before the positive is printed, but the special system adopted in the process allows this to be done satisfactorily. The result is a picture entirely free from colour changes depending on the angle of view. It is easily understood that, granted the registration is exact, the disappearance of the parallax between the positive and the screen will result in the elimination of diffusion between the edges of the corresponding square elements in the two layers and a consequent improvement of the 'saturation' of the colour rendering. It is claimed by the makers that these plates can be used effectively for reproduction purposes for half-tone work.

Of course, the chief difficulty in making half-tone blocks from screen plates with a regular pattern has been that the pattern of the screen plate is likely to clash with that of the half-tone screen and produce moiré effects. This difficulty can, however, be overcome by placing the lines of the two screens at a suitable relative angle, and using a very slight softening of the focus, it is a matter calling for some care and skill.

Development work recently in progress has been concerned with a screen-plate for photographic reversal, the application of the colour screen to kinematograph film, and the adaptation of a modified collotype process to the production of colour prints on paper, starting from the original screen-plate record. It is also claimed that it is now possible to reproduce the Finlay pictures in colour by colour gravure, collotype, and by photolitho offset. Many interesting and excellent pictures have been made for exhibition by these various processes.

In spite of difficulties and discouragements it seems that this screen-plate process should find an increasing sphere of interest and utility. Success will be the reward of a steady improvement and standardisation of the materials, and of persistent investigation of the various possibilities of the process in printing, in amateur and professional photography, and in science, but the experience of the last twenty years indicates that progress can best be made by persistent expansion from modest beginnings. L. C. M.

### Industrial Bursaries\*

IN articles in NATURE nearly two years ago (June 21 and 28, 1930), the late Sir Francis Ogilvie gave an interesting account of the development and work of the Royal Commission for the Exhibition of 1851.

At that date the Commissioners had just published the Record of their Science Research Scholars, of whom the first was appointed in 1891. The Record of their Industrial Bursars, now issued, tells of a more recent branch of that work, only just alluded to by Sir Francis Ogilvie, to whose help much of its success has been due. It affords further evidence, should that be needed, of the far-reaching extent and valuable results of the activities of the Commission.

Founded in 1851 to administer the surplus funds of the Exhibition, the Commissioners have for eighty years employed their resources generally in accordance with the lines laid down by the Prince Consort. "For its application", he wrote in the autumn of that year to Baron Stockmar, "I have devised a plan", and to this plan, with such minor modifications as changing times demanded, they have adhered. It has been their object to assist in the establishment of institutions which, in the words of their Supplemental Charter, "might increase the means of Industrial Education and extend the influence of Science and Art upon productive industry".

\* The Record of the Industrial Bursars of the Royal Commission for the Exhibition of 1851, 1911-1929. Published by the Commission, 1 Lowther Gardens, Exhibition Road, S.W. 7.

In 1911 the Science Scholarships had been established for twenty years, and their value was generally recognised. They had opened a scientific career to students from all parts of the Empire, and the results achieved by those students were even then of marked importance. Now forty of their scholars are on the roll of the Royal Society.

Among the means whereby improvement and progress can be obtained in any branch of knowledge, the Prince Consort noted the "acquisition of knowledge by ocular observation, comparison, and demonstration". To make this possible for their scholars was a primary object of the Commissioners. Knowledge must first be gained and scientific investigation advanced, but this alone did not extend the influence of science on productive industry. It was with this latter object, then, that their Industrial Bursary scheme was devised—directed, as stated in their Report for 1911, to encourage the training of 'captains of industry'. At that date the engineering faculties of the universities and the technical colleges established in many large towns were well organised. Students were leaving in numbers, who might with great advantage be utilised in factories and engineering works, but they were not welcomed. It was the object of the Commission to guide in the right direction this stream, broadened by the inflow of that practical experience without which the science of the schools was of little use to the engineer, the

electrician, or the shipbuilder. Such practical experience, they saw, could only be gained, in the future as in the past, by a period of apprenticeship, during which, in the opinion of most employers at that date, the apprentice was of little or no value and was paid accordingly. Since then conditions have changed to some extent, and far-seeing employers have come to recognise that it may be well worth while to pay an apprentice with a trained mind and a competent knowledge of science a living wage, because of the additional value he will possess in consequence of his previous college training, when he has acquired practical experience in the works or office.

However, in 1911, this was not the case, and the Commissioners—Lord Esher was their chairman, supported by Sir Arthur Rucker, and to their active help the scheme owes much—sent their secretary, Mr Evelyn Shaw, on a tour of the principal provincial universities and technical colleges to obtain information on which to base a plan for introducing more men with scientific training into industry. The secretary's conversations with the authorities of the institutions he visited led him to formulate the scheme of the Industrial Bursars which was afterwards adopted by the Commission. His scheme was a simple one, and from the first it worked. Each year a selected number of colleges and technical schools are invited to nominate students, desirous of entering industrial work, who have passed through their course with credit and are certified by their teachers to be suitable for such work, but are unable to meet the expense of an apprenticeship course without some financial help.

To these nominees some twenty or twenty-five bursaries are awarded. Each case is examined carefully: the Commissioners assure themselves that the man is competent—the school records and the statements of the teachers afford material for this, inquiry is also made as to his means, and not the least interesting part of the work has been the insight it has afforded into the efforts made by parents to secure for their children a college training and by the children to profit by it. An examination of the returns made to the secretary in some seventy pre-War cases taken consecutively from the Report gives these approximate averages: family income, under £175, number of children in family, 2.7, wage of bursar (per year), under £35.

The Record of the Industrial Bursars just issued gives the careers of about three hundred appointed.\*

\* The total number appointed has been 353, but a number obtained remunerative posts without assistance from the Commission, and for this reason their record is not included. The scheme was suspended during the War.

in the fifteen years up to 1929. The bursars are placed in selected works, chosen frequently by themselves, but subject to the approval of the Commissioners, who receive periodically reports as to the progress of their bursars. They are paid an amount which, with the wage received—in too many cases, only a small one—will bring the income of each man up to a sum on which he can live. The value of a bursary necessarily varies from man to man: in some cases the holder must spend from two to three years in learning the technique of his trade, for others a few months suffice, the average cost spread over the whole period works out at about £150 for each bursar.

The Record gives a list of the nominating institutions, with the number of bursars appointed from each, and continues with the names of the bursars and the period of their tenure. A statement follows as to the course of training and the subsequent career, so far as particulars are available. The compilation of these has involved no small amount of labour on the part of the secretary and his staff, who have well earned the thanks of the Commission—one may add, also, of the readers of their Record—for the interesting results of their work.

Of the bursars, some few have in the end devoted themselves to educational or scientific pursuits, while the War claimed a number among its victims; but the analyses at the end of the volume show that they are to be found holding responsible positions in the government services, the coal, iron and other allied industries, in every branch of engineering, as well as in the chemical, textile, and other leading trades. Of the three hundred whose careers are recorded, it will be found that, although the oldest among them cannot be much above forty years of age, at least forty have become directors or managers or reached some equally important positions. This fact in itself may fairly be cited as evidence that the scheme has rendered valuable service to industry, and while the need for a scientific training is now much more fully recognised than it was twenty years ago, and applications for suitable student-apprentices are made frequently to the universities employment bureaux, there is still need for the Industrial Bursary Scheme of the Royal Commission.

Much of the success of the scheme is due to the support given to it by employers, who have learned to appreciate the value of the trained men whom it supplies; it is no longer a pioneering effort but has gained the right to rank as one more of the successful endeavours made by the Commissioners to give effect to the "plan" devised by their founder.

R. T. G.

## Obituary

THE RIGHT HON. SIR HORACE PLUNKETT,  
K.C.V.O., F.R.S.

ON March 26 died Sir Horace Plunkett, after a brief illness, though it was only the culminating attack of many years of ill health. He was born in 1854 of distinguished stock belonging to one of

the oldest families of the Pale, the third son of the sixteenth Lord Dunsany. Educated at Eton and University College, Oxford, considerations of health led him to America soon after taking his degree, and there he took up cattle-ranching in Wyoming. He was successful enough to be able to return to

Ireland ten years later with a fortune and a stock of experiences from which his gentle humour often drew an illuminating commentary on the subject under discussion. His business interests took him back to America almost every year, and the friendships he formed with leading men in the United States were often of service in enlightening public opinion both there and here.

From 1890 onwards Plunkett threw himself wholly into the movement for the regeneration of Irish life and particularly of its agriculture. From the outset the movement aimed at remaining outside party and uniting men of all classes and creeds in the single cause of economic and social progress. In 1894 he launched the Irish Agricultural Organisation Society, the pioneer and for many years the example of agricultural co-operation in the English-speaking world. On its Board sat parish priests and Presbyterian ministers, landlords and tenants, Orangemen and Jesuits, and as they worked together in amity under Plunkett's inspiration they set a standard of public service that was new in Irish affairs. Soon afterwards Plunkett got together the famous 'Recess Committee', again representative of every grade of Irish opinion, and its Report was a detailed consideration of what could be done by the State to promote the regeneration of the agricultural and industrial life of the country. It bore fruit in legislation which set up in 1899 the Department of Agriculture and Technical Instruction with an endowment independent of Treasury sanction and the annual vote, and of this new body Plunkett was made vice-president, in effect, acting minister. Plunkett chose his lieutenants well, unorthodox as were the appointments from an Irish party point of view. Mr T P Gill was made secretary and administrative chief, Prof J R Campbell was brought from Leeds to organise the agricultural side, and Mr George Fletcher was put in charge of the general education—a Scotsman and an Englishman who rapidly removed any reproach of alien origin. Campbell's practical outlook and sympathy with the Irish peasant found expression in a different policy from that adopted in England, where efforts were chiefly directed to higher agricultural education, but as time went on its wisdom was abundantly justified.

The appointment, however, of T P Gill, who had been prominent in Nationalist politics, raised an immediate storm, so contrary was it to the strict tradition of Irish party life. The extreme conservatives started a vendetta against Plunkett, his seat was contested and he was defeated in 1900, and though he stood later for a Galway division he never succeeded in re-entering Parliament. He was allowed to retain his vice-presidency until the advent of a Liberal Government in 1906, when he had to resign. For the Nationalists had declared against him, they would allow no other organisation in Ireland, and the party drew much of its funds from the country traders, who felt threatened by the co-operative movement. Plunkett then resumed his presidency of the Irish Agricultural Organisation Society, and became more active than ever in his efforts for the reconstruction of Irish

rural life. About this time came his chief books, "Ireland in the New Century", "The Rural Life Problem in the United States", "Noblesse Oblige", and "Plain Talks to Irish Farmers", a series of articles in the *Irish Homestead*, the paper he had founded as the organ of the co-operative movement and for which he had enlisted George Russell (*Æ*) as editor. Plunkett had no great interest in literature as such, but he took infinite pains over his writing and succeeded in giving eloquent expression to his convictions. Meantime the co-operative movement, guided by the I A O S, was making steady progress, and in 1913 was allowed to receive a grant from the Development Commissioners in the face of the declared opposition of the Nationalist party. The War cut across all these activities, and the passions then let loose destroyed the hopes of those who saw in that body, where Nationalists and Ulstermen, Catholics and Protestants, worked harmoniously for a common purpose, the spirit out of which a new Ireland would grow.

In 1917, Plunkett was chosen chairman of the Irish Convention, a representative conference of Irishmen to draw up proposals for the future Constitution of Ireland. Plunkett laboured unweariedly and nearly achieved a success that would have saved much of the terrible aftermath of war in Ireland, but the extremists prevailed and the Convention broke down. It was in these later troubles that his house near Dublin, built by Plunkett as a home in which he could gather all friends of Ireland, was destroyed, and henceforward he lived in England. In 1919 he endowed the Trust which bears his name, a foundation charged to keep before the public the principles of rural betterment, and on its behalf he was still working until a few days before his death. In recognition of his services to the scientific development of agriculture, Plunkett was elected to the Royal Society in 1902, and at the Dublin meeting of the British Association in 1908 he was the chairman of the newly formed Sub-Section of Agriculture. He had no working acquaintance with science, and in one sense his mission was to counteract the disintegrating effects of science upon the old fabric of rural society, but he was interested in the progress of science and knew that science among things must be controlled by science among men. He had no hostility to modernities, he became an early and passionate motorist, and was learning to fly only three years ago.

Such were the main items in the life of one who was indeed the most unselfish of all public men of his time. Of his personality it is difficult to write, by one who was honoured by his friendship. He was the true aristocrat, dedicated to the service of others, beyond all suspicion of self-seeking, free even from vanity. He made friends in all classes and treated them all on the same terms, but he always preserved his quiet dignity, the dignity of one in pursuit of a noble ideal. In this pursuit he never wavered or spared himself, though he suffered from a succession of illnesses which might have given any man an excuse for withdrawal from unnecessary fatigue. *Noblesse oblige*

A D H

## MR H CHAPMAN JONES

THE death of Henry Chapman Jones on March 7, at the age of seventy-seven years, removed one who has held an honourable place in the teaching of chemistry and in the development of the science and practice of photography. Apart from an early association with Birkbeck College, Chapman Jones's career as a teacher of chemistry was bound up with the Royal College of Science, where he was successively assistant, demonstrator, and lecturer, from 1881 until 1914, when he retired. In the first few years of this long period he was on Sir Edward Frankland's staff, and later he served under T E Thorpe, W A Tilden, and H B Baker. For a number of years he presided over the North Laboratory in the old Royal College of Science buildings, and many who worked there will recall the quiet, serious, and kindly way in which he went about his duties, as well as the high standard of industry and accuracy which he expected of his students.

The main contributions to knowledge made by Chapman Jones were in the domain of photography, and were published principally under the auspices of the Royal Photographic Society. Following Sir William Abney in the application of scientific method to the problems of photography, Chapman Jones dealt with such matters as the densities of negatives, the factors affecting the sensitiveness of plates, media of high refractive power for photomicrography, and the relationship between the size of the particle and the colour of the image.

Besides original papers on these and other topics, Chapman Jones contributed many articles on photographic subjects to the technical press, while two books on photography came from his pen, namely, "Science and Practice in Photography", which ran to four editions, and "Photography of To-day", a popular treatise published in 1913. His associations with the Royal Photographic Society were very close, and after being honorary secretary from 1892 until 1897, and vice-president from 1897 until 1902, he became president of the Society in 1912. In addition, he was a fellow of the Chemical and Physical Societies and of the Institute of Chemistry.

Chapman Jones was a single-minded man, whose integrity and ideals were of the highest. His quiet, almost shy, old-world courtesy and his modesty were marks of an interesting personality which only those who knew him well could appreciate. At the same time, he held strong opinions on many subjects, and he did not hesitate to express these in his own direct, unimpassioned way. His gentle, warm-hearted nature revealed itself to best advantage in the circle of his own family and of those who knew him intimately. He is survived by a widow and two sons.

J C P

## DR MICHAEL PERKINS

MICHAEL GERARD LAURENCE PERKINS died, following an attack of scarlet fever which developed apparently into a general septicæmia, on March 14, at thirty-three years of age. Perkins was educated at St Peter's College, Westminster, King's

College, London, and Trinity College, Cambridge. He was Huxley Prizeman at King's College and a Senior Scholar of Trinity. He was elected to the Mackinnon Research Studentship of the Royal Society in 1925. He took his M A in 1926, his Ph D in 1930, and joined the Westminster Hospital Medical School in 1927.

Michael Perkins had many interests, his greatest love being that of natural history. He had a keen intelligence, a vivid imagination, and boundless enthusiasm and energy—qualities which might have earned him a prominent place in the ranks of science. He published work on the Coleoptera of Guernsey and Wicken Fen, on Cambridgeshire Planarians, and, becoming interested in the Crustacea, published in 1928 a simple key to the crabs (*Brachyura*) of Britain and the north-eastern Atlantic. His own observations on local varieties of a species of *Platyhelminthe* worm, of which the peculiarities seemed to be correlated with slight changes in environment, led him to take an active interest in the work of the late Dr Kammerer. It was partly through the influence of Perkins that Kammerer was invited by the Cambridge Natural History Society (of which Perkins had been secretary for two years) to demonstrate his specimens and to discuss his much-disputed experiments. Perkins' interest in the problems of parasitism brought him into touch with the remarkable sex change induced in crabs by *Sacculina*, a phenomenon which he studied from the biochemical point of view in Cambridge (see *NATURE*, 124, 299, 1929). He was also engaged upon work on the respiratory metabolism of bats.

Perkins' work was perhaps marred by the diversity of his interests, his restless mind preventing that concentration necessary for the successful completion of a single piece of work. Time, however, was steadying him, and there is much that is valuable in the mass of unpublished data left by him.

Perkins' lovable nature was his chief characteristic, his ready optimism, his wit, and his profound knowledge of a multitude of subjects, ranging from folklore to mystery plays, won him innumerable friends and made him a most agreeable and interesting companion. His boundless energy and zeal were ever at the service of others. His early death has come as a great shock to all who knew him and loved him so well. There are many who will sympathise with his bereaved parents in their great loss.

J H Q

WE regret to announce the following deaths

M Guillaume Bigourdan, president in 1924 of the Paris Academy of Sciences and formerly director of the Bureau International de l'Heure, on Feb. 28, aged eighty years.

Dr R M Bronte, pathologist to the Home Office and formerly Crown Analyst in Ireland, on March 22, aged fifty-two years.

Prof Wilhelm Ostwald, emeritus professor of chemistry in the University of Leipzig, Nobel prizeman in chemistry for 1909, and an honorary fellow of the Chemical Society, on April 4, aged seventy-eight years.



## News and Views

## Sir William Pope

By awarding the Messel medal to Sir William Pope, the Society of Chemical Industry has paid a well-deserved tribute to one of Great Britain's most distinguished chemists. Moreover, the news of the award will be received with interest and satisfaction outside as well as within the boundaries of his own country, for Sir William, as president of the Federal Council and a former president of the Union Internationale, is well known to foreign chemists as the principal ambassador of their British colleagues. He held office from 1917 until 1919 as president of the Chemical Society, and from 1920 until 1921 as president of the Society of Chemical Industry. Sir William Pope, who was born in London in 1870, was one of Prof. H. E. Armstrong's pupils, having studied chemistry at the Finsbury Technical College and at the Central Technical College (now an integral part of the Imperial College of Science and Technology) at South Kensington. In 1897 he became head of the chemical department at the Goldsmiths' Institute, New Cross, and in 1901 became professor of chemistry at the Municipal School of Technology, Manchester, in 1908 he was appointed professor of chemistry and director of the Chemical Laboratories at Cambridge. Sir William's greatest triumphs in the domain of original research are associated with advances in stereochemistry, but other studies, for example, those with Dr. W. H. Mills on photographic sensitizers, are equally important and well known. Working in collaboration with Peachey, he succeeded in 1889 in resolving phenylbenzylmethylallylammonium iodide, an optically active compound containing an asymmetric nitrogen atom, and so demonstrated the quinquivalence of nitrogen. This extension of the scope of stereochemistry beyond the range of asymmetric carbon compounds was followed by the preparation of optically active substances containing asymmetric atoms of sulphur, selenium, and tin. In association with Barlow, he published work on the relation between chemical composition and crystalline form which led to interesting conceptions concerning the size and arrangement of atoms.

## Mellon Institute of Industrial Research

MR. ANDREW MELLON, the newly appointed American Ambassador in London, has a claim to fame in relation to the promotion of scientific research which has escaped recognition in announcements of his appointment. He and his brother, Richard B. Mellon, gave their name and a generous benefaction to the Mellon Institute of Industrial Research in the University of Pittsburgh. Of the original benefaction of £100,000, half was used to provide the permanent building accommodating 70 research workers, £12,000 for equipment and apparatus, £4000 for the chemical library, and £8000 a year for at least five years for maintenance. The objects of the Institute are stated to be "The increase of useful knowledge through the application of contemporary science to industrial processes, the promotion of American industry, and

providing opportunities for the training of men for high industrial appointments, and, in addition to this, the training of men in advanced chemical engineering and industrial chemistry for specific industries." The principles on which the work of the Institute was based were enunciated by the first director, Prof. Robert Kennedy Duncan, and were explained for English readers in Educational Pamphlet No. 30, entitled "An Experiment in Industrial Research", by T. Ll. Humberstone, published by the Board of Education in 1915. It is a tribute to the wisdom of the founders of the Mellon Institute, and the essential soundness of the principles on which the Institute is based, that the Liberal party in an official statement of policy recently published has urged the establishment in Great Britain of an institute on similar lines.

## Industrial Bursaries

It is now almost platitudinous to say that industrial efficiency can be furthered by the introduction into works and factories of men trained in science and ready to use such training in industrial pursuits. The difficulty, however, is to find really suitable openings for students whose special scientific training will ultimately fit them for responsible posts. It is true, of course, that employers are realising more and more the value of such men to industry, but it is not always easy for students to gain practical experience when their financial position is such that they cannot accept employment at the nominal remuneration which usually accompanies the 'learning period' in industry. In these cases the Industrial Bursaries of the Royal Commission of 1851 are specially useful. The scheme is designed to assist "young men who, after a course of training in a University or approved technical college, desire to take up Engineering, Chemical or other industrial work." It has no intention of facilitating collegiate studies, it is solely "to enable suitable applicants to tide over the period between their leaving college and obtaining remunerative employment in industry." To carry out its full intention, the candidate must be under twenty-five years of age, must have been a *bona fide* student of science for three years, must be able to obtain an industrial post approved by the Commissioners, and must be in need of pecuniary assistance to enable him to hold such a post. He is not allowed, except in particular circumstances, to accept less than the standard wage. Elsewhere we publish an article dealing with the record of bursars appointed between 1911 and 1929, and we shall not, therefore, deal with the actual record here. In spite of that part of the regulation which we have indicated above, however, it would appear that the bursars were nominated chiefly by universities only the Heriot Watt College, Edinburgh, would fall under the heading of "approved technical college." We would, therefore, direct the attention of technical colleges to the scheme, for we feel that it would be of enormous value to students who may not contemplate proceeding to universities.

but whose whole training fits them admirably to fulfil just that purpose which the Commissioners have in mind

#### Volcanic Eruptions in the Andes

ALARMING reports of vast showers of volcanic ash from eruptions of Descabezado and other recent volcanoes of the group which occurs on the chain of the Andes south of Santiago de Chile, appeared in Tuesday's daily papers. The eruptions began on April 10, and the neighbouring towns of San Fernando, Curico, and Talca were said to be in darkness through the fall of fine dust from the volcanoes. The ash is reported to be three feet deep in Curico. Trains arriving at Mendoza, on the line about a hundred miles east of Santiago, were covered with volcanic dust, and the streets of the city were thickly coated with it. At Buenos Ayres, which is about six hundred miles farther east, there has been a steady fall of volcanic ash, and even at Monte Video (Uruguay), still farther east, the shower of dust is reported to have lasted for ten hours. Shocks have been felt over a wide area, but at the time of going to press no details are available as to the actual character of the eruptions or exactly what volcanic peaks have again come into activity.

#### Overlapping of Government Research Funds

It has been common knowledge, amongst those conversant with such matters, that a certain amount of overlapping has existed in connexion with the grants made by Government to various bodies who utilise the money for assisting research and other work in the British Empire. The system underlying these grants has developed by instalments and does not, therefore, represent a carefully thought-out scheme. For this reason the first report of the Estimates Committee, of which Sir Vivian Henderson is chairman, recently presented to the House of Commons, will be welcomed. It is understood that the Committee has examined the estimates of the following funds: Empire Marketing Board, Colonial Development Fund, Development Fund, Ministry of Agriculture, Colonial and Middle Eastern Services, and University Grants Committee. The Estimates Committee's object was to ascertain to what extent in recent years Parliament has been asked for funds to assist the same object or body through different channels, since the Parliamentary estimates do not themselves indicate clearly the sources of the demand. The Committee has noted, for example, that grants are being allotted to the Empire Marketing Board for many purposes which are also assisted by the Development Fund, the Forestry Commission, the Ministry of Agriculture, or the Department of Scientific and Industrial Research. Again, in the case of the Colonies, grants are being made from the Colonial Development Fund for the ordinary purposes of Government, whilst at the same time, the Colony concerned may be receiving a grant from the Colonial Office. It is not suggested that the departments or bodies receiving such grants are in ignorance of what is being done by others working on the same lines, but the fact remains, as the Committee

remarks, that many institutions in Great Britain are receiving assistance from the State through two or three, or even as many as four or five, or more, channels. This position of itself justifies the appointment of the Estimates Committee, the work of which should also prove of service to Government at the Ottawa Conference.

#### Race Prejudice and World Peace

SIR ARTHUR KEITH in his address, "Can Race Progress be Rationalised?", delivered on April 5 at Oxford, before the Universities Congress of the National Union of Students, turned once more to the problem of world peace as it presents itself to him as an anthropologist and a follower of Darwin. As he has expressed himself on more than one previous occasion, Sir Arthur is convinced that racial and national instinct is an all-powerful factor in the evolutionary progress of mankind, producing new and, perhaps, better races; but, as he points out, this spirit is incompatible with man's economic needs, and the result is the disharmony which is to be seen in the world to-day. Granting that this spirit is ineradicable, and accepting the inevitable consequence that the nations of the world can never be welded into a whole, is it then possible, Sir Arthur asks, to bring about conditions in which each nationality may work out its destiny by peaceful progress? Ethically the nations of to-day are in no respect superior to their predecessors, each pursues its own ends selfishly. Nothing daunted, Sir Arthur sees hope for the future in such manifestations as the suppression of separatist tendencies by reason in Scotland and Wales, and in the spread of English-speaking peoples, which he regards as the greatest attempt to rationalise the peoples of the world that has ever been made. Race progress, he concludes, can be rationalised only by a process of self-understanding, self-education, and, if need be, self-sacrifice on the part of all.

#### Roman Mining in Britain

In a paper on Roman mining in Britain, read before the Newcomen Society on March 30, Mr. G. C. Whittick gave a review of the mining operations during the whole of the Roman occupation. Though the Roman invasion cannot be ascribed chiefly to the desire to gain possession of the country's mineral wealth, after the initial seizure of the south-east of the island, there followed the inevitable accompaniment of the exploitation of minerals, particularly lead. After referring to the mining methods, to the treatment of ores, and to the question of organisation, Mr. Whittick dealt with the mining of coal, gold, copper, lead, iron, and tin. During the first century and a half of the Roman occupation, lead was the most important product of Britain. Lead mining in the Mendips was apparently begun so early as A.D. 49, and production rose rapidly during the reigns of Nero (A.D. 54-68) and Vespasian (A.D. 69-79). The centre of Roman activity in the district was in the valley of the Blackmoor, just south of Blackdown. The ore was obtained from surface workings, and from the waste heaps of the workings many pigs of Roman lead have been recovered. Lead was also

mined in Flintshire, Derbyshire, Yorkshire, and Shropshire. Most of the pigs which have been found bear inscriptions, and some have been officially stamped showing that they had been desilverised. The iron-workings of the Roman period were concentrated in the Weald and in the Forest of Dean, and tin mining was carried out to a small extent in Cornwall.

#### Velocity of Light

MR M E J GHEURY DE BRAY, 40 Westmount Road, Eltham Park, London, S E 9, has published, in the form of a pamphlet entitled "La vitesse de la lumière", a critical and documented discussion of the chief experiments made to determine this constant, from the pioneer work of Romer and of Bradley, down to the latest experiment devised by Michelson. The experiments are carefully analysed, and the accounts contain discussions of certain errors, obscurities, and irrelevancies which disfigure the presentation of the subject in many of the texts. The description of the observations of Romer and of Bradley is specially useful. The author presents a table which shows the results of some twenty-one experiments, beginning with that of Fizeau in 1849 and concluding with the recent work of Michelson. Of these experiments he decides, after critical consideration, that seven give trustworthy results. He divides these into two groups—experiments carried out on a short base line and those carried out on a long base line. The results are summarised as follows:

##### (1) Bases courtes, inférieures à 4 Km

|        |           |         |
|--------|-----------|---------|
| 1879 5 | Michelson | 299 910 |
| 1882 7 | Newcomb   | 299 860 |
| 1882 8 | Michelson | 299 853 |

##### (2) Bases longues, 23 Km et plus

|        |               |         |
|--------|---------------|---------|
| 1874 8 | Cornu-Helmert | 299 990 |
| 1902 4 | Perrotin      | 299 901 |
| 1924 6 | Michelson     | 299 802 |
| 1926 0 | Michelson     | 299 796 |

The conclusion reached is that "un fait très remarquable est tout de suite révélé par cette classification dans les deux groupes, la vitesse de la lumière diminue progressivement avec le temps, et le changement de vitesse est approximativement proportionnel à l'intervalle de temps correspondant." However this may be, there is no question that Mr Gheury de Bray has provided a useful résumé of the literature dealing with a very difficult experimental problem.

#### Ocean Newspapers

SINCE the first issue of the *Transatlantic Times*, which appeared in the form of a leaflet on the *ss St Paul* on Nov 15, 1899, maritime journalism has made great progress. All newspapers issued on British ships are now published by an organisation known as the Wireless Press. In the first place, it supplies ships with copies of the journals prepared in such a way that the news can be printed on board ship as it is received by the ship's radio operator. Rugby Radio, the G P O wireless station, daily transmits three news bulletins—in the early morning, at midday,

and during the evening. It also transmits a Saturday night message giving the League football results. This message is in keen demand among the crews on cargo boats all over the world. In the case of general elections, big races, and other events of world-wide interest, it often happens that a passenger in mid-Atlantic is reading the results before they have been distributed on land. The special bulletins, broadcast throughout the day, are exhibited prominently for the passengers to read. Foreign stations also bombard the ship with news. The ship's purser has the task of sub-editing the newspaper. In an interesting paper on maritime journalism, by E C Thomson, in the *Wireless World* for March 23, it is stated that there are indications that the 'wireless news' will give place, possibly at no distant date, to a replica of a journal printed on land. This could be achieved without much difficulty by means of facsimile telegraphy. A complete page printed on land could be reproduced on board ship in a shorter time than would be required to carry the actual newspaper from one end of Fleet Street to the other.

#### Archæological Exploration in Macedonia

THE recently issued *Annual of the British School at Athens*, No 30, covers the sessions 1928–29 and 1929–1930 (London: Macmillan and Co., Ltd., £3, 3s). In addition to the annual report and financial statement, it includes the usual complement of papers by members of the School. The excavations in Macedonia have been continued, and although the account of the work carried out by Mr W. A. Heurtley and others at Saratse provides no sensational discovery, it demonstrates the relation of cultural development in an interesting strip of country to that of the Vardar valley and the area immediately around Salonika. A Troadic site at Thermi in Lesbos was excavated by Miss W. Lamb, who describes the five successive cities of an Anatolian colony which was finally abandoned some time before the sack of Troy II. The excavations are still incomplete after two seasons' work. Messrs J. D. and H. W. Pendlebury describe two extensive and elaborate protopalatial houses at Knossos, found at the bottom of walled pits in the west court. It is unfortunate that owing to their position they cannot be excavated, but a somewhat hazardous feat of exploration has revealed their character to a considerable extent. The first instalment of a study of the morning hymns of the Emperor Leo by Prof. H. J. W. Tillyard provides evidence on medieval methods of musical notation of considerable interest to students of early music. Mr J. D. Beazley's "A Dancing Maenad" is a study of the grouping and meaning of figures on a Nolan amphora from Woburn Abbey. Nearly half the volume is devoted to the continuation of the final report on the School's important excavations at Sparta in 1924–28 by the former director, Mr A. M. Woodward.

#### Animals Playing at being Hunted

A HAND-REARED female of the prongbuck, or American antelope, owned by Mr L. T. Murray at Mertzon in Texas, displayed a most remarkable

originality in getting itself hunted, as related by its owner in the *Journal of Mammalogy* for February, p 41 Its habit, as it was allowed complete liberty, was to go to the main street of the little town and entice dogs to pursue it, the resulting hunt might last as long as three-quarters of an hour, at the discretion of the doe, which had so much the advantage of her pursuers in speed and intelligence that she did as she liked with them, fleeing in pretended fear, circling and waiting for them to come up, and then darting off in the opposite direction, until at last she left the pack behind and went home It is satisfactory to learn that she came to no harm and was ultimately sent to a park and bore twins, but it would be interesting to know if playing at being hunted is a recreation indulged in by animals we usually regard as food for others, when they live in the natural state That the hunters may play at hunting we know from what has been observed of the puma and the peregrine falcon

#### Excavations in Texas Caves

THE Smithsonian Institution, it is announced through Science Service, of Washington, D C, is sending an expedition to the caves of western Texas in charge of Mr Frank M Setzler, staff archaeologist The object of the expedition is to obtain evidence of the culture of the early cave dwellers of this area, and if possible to ascertain their relation to the basket makers who preceded the Pueblo-Indians of the south-western states Traces of the basket-makers' culture have already been found in Texas caves, but there is also evidence, in spear points of stone associated with the bones of extinct animals at some depth below the earliest basket-maker relics, of an earlier people

#### Modern Aids to Teaching

A QUARTERLY review of modern aids to teaching, entitled *Sight and Sound*, has been published under the auspices of the British Institute of Adult Education The first issue contains thirty pages, and is illustrated It is edited by a committee appointed by the Institute, and its purpose is to promote interest in the use of modern scientific inventions, such as the film, gramophone, wireless, and television, in schools and colleges and in general cultural work The gramophone and wireless have already shown their usefulness in the teaching of languages and music, one of the articles in the issue maintains that the teaching film should be planned, made, and used in the school

#### New Physical Apparatus

In their new catalogue, No 115X, of forty pages, Messrs Griffin and Tatlock, Ltd, give an account of some new models of physical apparatus designed for use in the teaching of physics Under the name Microid Physical Series some twenty new designs have been produced, based for the most part on modern research methods Each apparatus is described in a 'specification', and this is followed by 'experimental notes' which will be useful to the teacher and the student, especially as in many cases numerical results from an actual experiment are

quoted As indicating the type of apparatus included, mention may be made of the microcel thermopile, the thermo-magnet illustrating the heavy currents obtainable from thermo-elements under suitable conditions, the magnetic potentiometer (Chattock), and the moment of inertia apparatus with rotating table Experiments are also included on light, such as the parallel plate refractometer, and heat, such as the micrometer expansion apparatus, to mention only a few of the methods described References are given to the textbooks of Pohl, Searle, and Worsnop and Flint Teachers of physics will find here many suggestive hints for experimental work

#### Announcements

DR DUKINFELD H SCOTT, F R S, the eminent palaeobotanist, has been elected a corresponding member of the Prussian Academy of Sciences

THE Faraday Medal of the Institution of Electrical Engineers will be presented to Sir Oliver Lodge at the ordinary meeting of the Institution to be held on April 21 at 6 p m The presentation will precede the twenty-third Kelvin Lecture, which will be delivered by Dr W E Sumpner, on "The Work of Oliver Heaviside"

UNDER the auspices of the British Science Guild, Prof S Chapman, professor of mathematics at the Imperial College of Science and Technology, will deliver a popular lecture on "Polar Lights", on Wednesday, May 25, at 5 p m The lecture will be at the Royal Society of Arts, John Street, Adelphi, W C 2 Tickets, for which no charge is made, can be obtained on application to the Secretary, British Science Guild, 6 John Street, Adelphi, W C 2

THE Dyers' Company Gold Research Medal for the period 1930-31 has been awarded to Prof F M Rowe, professor of colour chemistry and dyeing in the University of Leeds, for a series of three papers on the chemical and physical effects of kier boiling on insoluble azo colours on the fibre This is the third occasion on which Prof Rowe has received this medal, the earlier awards being made for the periods 1924-25 and 1926-27 for his investigations of other aspects of the chemistry of azo colouring matters

PROF W L BRAGG, F R S, professor of physics, Victoria University of Manchester, the Rev Canon H Maynard Smith, Canon Residentiary of Gloucester, and the Right Hon J. H. Whitley, chairman of the British Broadcasting Corporation, formerly Speaker of the House of Commons, have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service

THE following appointments to the Colonial Agricultural Service have recently been made by the Secretary of State Mr W E Bassett, formerly assistant superintendent, Victoria Botanic Gardens, Nigeria, to be assistant agricultural officer, Dominica, Mr T R Hayes, superintendent of agriculture, Gambia, to be agricultural officer, Uganda, Mr F L Squibbs, assistant agricultural officer, Leeward

Islands, to be assistant director of agriculture, Seychelles, and Mr I G C Squire, assistant manager, Oil Palm Plantations, Sierra Leone, to be manager, Government Plantations, Zanzibar

THE American Association for the Advancement of Science will hold its second summer meeting at Syracuse, New York, on June 20-25. The third summer meeting will be held at Chicago in connexion with the Century of Progress World's Fair on June 19-30, 1933. The centre of this meeting at the World's Fair will be the Hall of Science, in which nearly ten acres of floor space will be devoted to science exhibits. Seventy-five European men of science will be invited to attend this meeting as guests of the American Association.

THE twenty-second annual May lecture of the Institute of Metals will be delivered by Dr F Korber, director of the Kaiser-Wilhelm-Institut für Eisenforschung, Dusseldorf, on Wednesday, May 11, at 8 P.M., at the Institution of Mechanical Engineers, Storey's Gate, Westminster, London, S.W.1, the subject of the lecture being "The Plastic Deformation of Metals". Cards of invitation may be obtained from Mr G Shaw Scott, 36 Victoria Street, S.W.1.

THE amalgamation of the Optical Society and the Physical Society of London has been under consideration for some time. It has now been decided to proceed with the amalgamation. Certain alterations are to be made in the articles of association of the Physical Society, and, in due course, a general meeting of the Optical Society will be held to wind up the Society.

FARMERS' and farm workers' associations and clubs, chambers of agriculture and horticulture, students' societies, and other bodies interested in agriculture or market gardening are invited to inspect the Rothamsted and Woburn Experimental Plots during the coming summer. Mr H V Garner and Capt E H Gregory will be available to demonstrate the plots. All communications and requests to visit the Stations should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden.

THE autumn meeting of the Iron and Steel Institute will be held in London on Sept. 13-15, concurrently with that of the Institute of Metals. It has been provisionally decided that at least one joint session shall be held at which papers of interest to the members of both Institutes shall be presented and discussed. Other sessions will be held separately but concurrently.

At the recent annual meeting of the Institution of Automobile Engineers, Major C G Nevatt was elected president of the Institution for the session 1932-33. The summer visit of the members of the Institution will this year take the form of a four days' trip up the Thames to Oxford on June 8-11, including visits to Morris Motors, Ltd., and the Pressed Steel Works of Great Britain.

ANOTHER of the valuable catalogues (No. 456) of Messrs Bernard Quaritch, Ltd., 11 Grafton Street, W.1, has reached us. It deals with nearly 1500 works on zoology, geology, and palæontology, and should be

of interest to students of these branches of science and to librarians.

MESSRS Bowes and Bowes, 1 Trinity Street, Cambridge, have just published a catalogue (No. 461) entitled "Old-time Literature (a third Catalogue), principally of XVIIth and XVIIIth centuries", containing particulars of nearly 1700 second-hand books on a variety of subjects, several of which relate to scientific matters.

THE following books are announced for early publication by Messrs Longmans and Co., Ltd.: "The Causes of Evolution", Prof. J B S Haldane, "A Manual of the Flowering Plants and Ferns of the Transvaal, with Swaziland, South Africa", Dr J Burt Davy—Part 2, "Malvaceæ to Umbelliferae" (completing the Archichlamydeæ), "Modern Methods in Quantitative Chemical Analysis", Drs A D Mitchell and A M Ward, "Modern Practice in Mining", Sir Richard Redmayne—Vol. 5, "Colliery Machinery and its Application", "Steam Engine Theory and Practice", Prof W Ripper, new and revised edition, edited by Prof W J Goudie, "Elements of Steam Power Engineering", Dr O Sneed, and "Graphical Geometry", E N Digweed.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.—Male laboratory assistants, Grade II, at the Royal Arsenal—The War Department Chemist, B 47, Royal Arsenal, Woolwich, S.E.18 (April 23). A veterinary assistant at the Veterinary Laboratory of the Ministry of Agriculture and Fisheries, New Haw, Weybridge—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (April 25). An assistant master at the Mining and Technical Institute and Junior Technical Day School, Neath, with a degree in engineering and works experience in engineering—The Director of Education, County Hall, Cardiff (April 25). A woman demonstrator in inorganic and physical chemistry at the Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N.W.1 (April 30). A lecturer in botany at the Wigan and District Mining and Technical College—The Principal, Wigan and District Mining and Technical College, Wigan (May 2). An intelligence officer in the Engineering and Metals Section of the Department of Overseas Trade—The Chief Establishment Officer, Department of Overseas Trade, 35 Old Queen Street, Westminster, S.W.1 (May 5). Assistant civil engineers in the Civil Engineer-in-Chief's Department, Admiralty, and H.M. naval establishments at home and abroad—The Civil Engineer-in-Chief, Admiralty, S.W.1 (May 14). An assistant master at the Leyton Technical College, with a degree in engineering or its equivalent and experience in teaching—R J Geldart, 280 High Road, Leyton, E.10. An assistant chemist under the Research Association of British Paint, Colour, and Varnish Manufacturers—The Paint Research Station, Teddington, Middlesex. A laboratory steward in the Department of Physics of St. Thomas's Hospital Medical School—Dr J H Brinkworth, Physics Department, Medical School, St. Thomas's Hospital, S.E.1.

## Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

## Hexuronic Acid as the Antiscorbutic Factor

EXPERIMENTS are being carried out in order to decide whether 'hexuronic acid' is the antiscorbutic factor. So far as is known, the distribution of this acid in plants follows closely the distribution of vitamin C. In the animal body it can also be found in relatively high concentration in the suprarenal cortex. Its chemical properties closely agree with the known properties of the vitamin. It was discovered and isolated several years ago at the Biochemical Laboratory, Cambridge.<sup>1</sup>

The hexuronic acid used in the present series was prepared in crystalline form from beef suprarenal glands two years ago at the Chemical Department of the Mayo Clinic.<sup>2</sup> As is known, 1.5 c.c. of lemon juice is the minimum protective dose for guinea-pigs against scurvy. This quantity of lemon juice contains approximately 0.5 mgm of hexuronic acid. 1 mgm of the acid has been given to our test animals daily, since, owing to the long exposure to air, some of our hexuronic acid preparation may have been decomposed.

The general procedure used in studying the antiscorbutic activity of hexuronic acid was that recommended by Sherman and co-workers.<sup>3</sup>

The test period in the first experiment consisted of 56 days. At the end of that time the guinea-pigs which had been receiving hexuronic acid, as well as the positive controls which received 1 c.c. of lemon juice, were chloroformed. The positive controls showed mild scurvy on autopsy, while the animals receiving hexuronic acid showed no symptoms of scurvy at all. The negative controls, which received the basal diet only, had an average survival of 26 days and had typical symptoms of scurvy. In this experiment, however, only a small number of animals were used, and the animals receiving hexuronic acid, as well as the positive controls, were losing weight continually because the basal diet employed at that time contained no milk powder (it consisted of rolled oats, bran, butter fat, and salt). For this reason we decided to repeat the experiment.

In the test which is in progress at the present time the defects mentioned above have been remedied. A large number of animals has been used, and skimmed milk powder has been added to the basal diet.

The test was composed of the following groups: (1) Negative controls receiving the basal diet only, 9 animals. (2) Positive controls, receiving 1 c.c. of lemon juice daily, 8 animals. (3) Test animals receiving the basal diet and 1 mgm of hexuronic acid daily, 10 animals. (4) Controls receiving mixed diet, 10 animals.

The negative controls all died between the time limit of 20-34 days, with an average survival of 26 days, after a continuous and big drop of weight. They all had symptoms of severe scurvy.

At the end of 55 days all the animals receiving hexuronic acid, as well as the positive controls with lemon juice or mixed diet, were living apparently in good health and were gaining weight consistently. At this time three animals which received hexuronic acid and two animals which received lemon juice were chloroformed. Mild symptoms of scurvy were present

in the positive controls with lemon juice, but no signs of scurvy in the animals receiving hexuronic acid.

The test will be continued until the ninety-day period is over, and full details will be published later.

This research was supported by the Ella Sachs Plotz Foundation.

J. L. SVIRBELY \*

A. SZENT-GYORGYI

Institute of Medical Chemistry,  
University Szeged, Hungary

\* Holder of an American-Hungarian Exchange Fellowship, 1931-32, from the Institute of International Education, New York.

<sup>1</sup> Szent-Gyorgyi, A., NATURE, May 28, 1927. *Biochem. J.*, 22, 1387, 1928.

<sup>2</sup> Szent-Gyorgyi, A., *J. Biol. Chem.*, 90, 385, 1931.

<sup>3</sup> Sherman, H. C., La Mer, H. K., Campbell, H. L., *J. Am. Chem. Soc.*, 44, 165, 1922.

At the wish and by the courtesy of Prof. A. Szent-Gyorgyi, I arranged to examine in my laboratory the 'hexuronic acid' which he isolated while working in the Biochemical Laboratory, Cambridge. At the end of 1929 he sent me 10 grams of the substance, which had been prepared in the chemical laboratory of the Mayo Clinic, Rochester, U.S.A. Owing to the value and scarcity of this material, it has been necessary to carry out each experiment with very small quantities, and to establish with much deliberation and care the experimental conditions and controls. This work is still in progress and is being directed to the elucidation of the constitution and the achievement of the synthesis of the substance, this has involved the study of its chemical properties, and the formation of a crystalline derivative. The preliminary results now communicated show that the hexuronic acid is most probably the 6-carboxylic acid of a keto-hexose, which does not appear to be related either to *D*-fructose or to the ketose corresponding to *D*-galactose. This work has been conducted by my colleague Dr. E. L. Hirst, assisted by Mr. R. J. W. Reynolds, whose report is given in the accompanying note.

W. N. HAWORTH

University of Birmingham,  
March 28

THE 'hexuronic acid' prepared from suprarenal glands by Prof. Szent-Gyorgyi was a cream-coloured micro-crystalline powder, m.p. 184°-187° (decomp.). On recrystallisation from methyl alcohol-ether the substance was obtained in irregular aggregates of rectangular crystals, which were almost colourless. No change in m.p., analysis, or other properties was observed even after several successive crystallisations. The crystals showed brilliant colours when observed between crossed nicols in a polarising microscope. Before and after recrystallisation the same analytical figures were obtained (Found: C, 41.0, H, 4.7.  $C_6H_8O_6$  requires C, 40.9, H, 4.5 per cent). Neither nitrogen nor methoxyl was present. In aqueous solution the rotation  $[\alpha]_D^{20} +23^\circ$  (c 1.1) increased slowly to  $+31^\circ$  (3 days) and then decreased to zero (11 days).

The hexuronic acid reduced Fehling's solution, neutral silver nitrate, and neutral potassium permanganate in the cold. It gave the Mohr's test and the orcinol reaction, but failed to show the naphthoresorcin colour test characteristic of glycuronic acid.

The hexuronic acid was monobasic (40 mgm of sodium hydroxide neutralised 172 mgm of substance—calc. for  $C_6H_8O_6$ , 176).

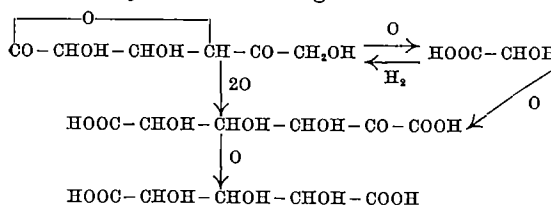
Oxidation by atmospheric oxygen in slightly alkaline solution, with a trace of copper as catalyst, introduced one carboxyl group in place of a primary alcohol



group and the product reduced Fehling's solution. Oxidation to the same stage occurred with remarkable rapidity when the hexuronic acid reacted with neutral, acid, or slightly alkaline potassium permanganate. The reaction, which required two atoms of oxygen per molecule of the substance, was thereafter much less rapid but proceeded regularly in the cold until one further atom of oxygen per molecule had been absorbed. The product was now non-reducing.

When heated with phenylhydrazine in dilute acetic acid, the hexuronic acid gave intractable, dark-coloured, amorphous products which could not be purified. The action of *p*-bromophenylhydrazine in dilute acetic acid on the barium salt of the hexuronic acid (compare Goldschmidt and Zerner, *Monatsh*, 33, 1217, 1912) gave a dark red micro-crystalline powder which, after recrystallisation from alcohol, had *m* p 230°-235° (decomp). Analysis showed it to be the *p*-bromophenylosazone of a hexose-uronic acid (Found C, 40.8, H, 3.5, N, 11.1, Br, 30.3.  $C_{18}H_{18}O_5N_4Br_2$  required C, 40.7, H, 3.4, N, 10.6, Br, 30.2 per cent). Control experiments with glycuronic acid and galacturonic acid failed to give the above substance. With glycuronic acid Goldschmidt and Zerner's barium salt of the *p*-bromophenylosazone of glycuronic acid was obtained, whilst the galacturonic acid gave a yellow powder which appeared to be mainly the barium salt of the corresponding galacturonic acid derivative.

The above reactions, together with Prof Szent-Gyorgyi's observation that oxidation by iodine in the cold removes two atoms of hydrogen, which are easily replaced by mild reducing agents, can be understood most readily on the following basis



Inasmuch as the configuration and ring-structure of the lactone of the hexuronic acid have not yet been established, the structural formulæ are given above in the open chain form, although the sugar-ring is most probably that of a keto-furanose.

E. L. HIRST  
R. J. W. REYNOLDS

Chemistry Department,  
University of Birmingham,  
March 28

### Biological Estimation of the Quality of Sewage Effluents

It is known that certain motile Protozoa and Bacteria gather near the surface film in water containing organic matter.

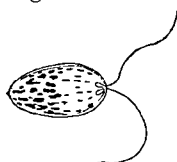


Fig 1 — *Polytoma uvella*, Ehr × 550, in Dobell's Iodine

*Polytoma uvella*, Ehr (Fig 1), one of the Phytoflagellata, in narrow upright tubes rests in a stable zone about 4 mm below the meniscus, and this reaction may be utilised in detecting organic impurities in water and estimating the biochemical oxygen demand of sewage and sewage effluents.

This organism abounds in the final settlement tanks at the Leeds Sewage Works. Cultures are obtained by aerating the humus from these tanks, *Polytoma* increasing in the supernatant fluid as the humus clarifies. Sub-culture is done in tubes of one-inch diameter. Equal parts of humus and bacteria

bed effluent are placed in these and partially sterilised in a water bath for an hour at 80° C. Boiling destroys the colloidal nature of the medium. The tubes are then inoculated from the previous culture, are kept at room temperature, and are not closed.

The working of the test depends partly on capillarity and is carried out in tubes of 4 mm bore. These are graduated 5 mm from the bottom and 40 mm above

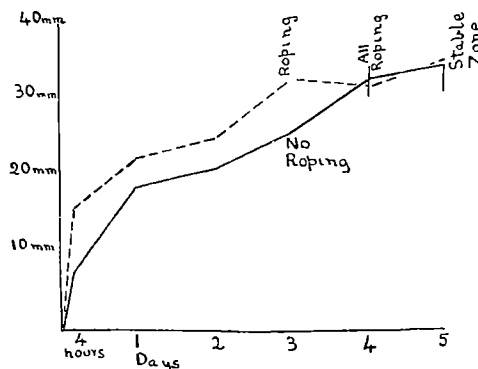


Fig 2 — Climbing of *Polytoma* 'blanket' in tap water, mean of four tubes, continuous line, and in deoxygenated tap water, one tube, broken line. Tests start simultaneously. Temp range 49°-55° F. Deviation from mean is shown where scale permits.

this mark. The supernatant fluid of a culture is placed in the tube to the lower mark by means of a fine pipette provided with a long glass bead near the orifice to protect against fouling the sides. The water to be tested is run gently on to this to the upper mark

by an ordinary fine pipette. Inoculum and water lie distinct, and the exact distance to the meniscus is measured. The *Polytoma* gather at the junction in a formation which is called a 'blanket' on account of its characteristic appearance. This blanket mounts the tube at a speed which bears a close relationship to the purity of the water. The order of the movement is illustrated in the charts. In Fig 1 the rate of rise in ordinary and deoxygenated tap water is contrasted. In Fig 2 the manner in which the *Polytoma* detects slight contamination of the water is shown.

When the oxygen in solution is below one part in 100,000 parts of water, the blanket is sensitive to very slight differences, the less oxygen present, the more rapid the rise. When an excess of oxygen is present, the blanket is by so much depressed into the depths of the inoculum. Light and darkness and variations in the pH of the water are of no account, and the reaction proceeds steadily at all ordinary room temperatures. The presence of nitrates and nitrites in the water in amounts such as occur in sewage effluents retards the rate of rising.

In crude sewage or other highly polluted waters, the blanket disperses and regathers at the meniscus in less than an hour. Heavy roping is usual from this position in bad water. In tap water, the upward progress is steady, and in a few days the blanket reaches its stable zone well below the meniscus, and there remains. Between these wide differences in behaviour, all intermediate conditions have been observed. It is thus possible to refer waters to a series of grades in contrast to tap water, controls of which are included in every series. Five grades can be defined at present from readings made at the end of one hour and of four hours respectively. Subdivisions of the worst grade are rendered possible by suitable dilution of the fluid tested with tap water.

*Spirillum* is present in the cultures and possibly plays some part in the reaction. In young cultures, it accompanies the *Polytoma* in its climb, and may form

a conspicuous layer in the blanket. Cultures from 3 to 8 days old react best when *Spirillum* is not too abundant. With older ones, the *Polytoma* becomes sluggish, and its rise may be delayed for a day, except in foul waters. In a reaction thus delayed, *Spirillum* may leave the inoculum first, and the *Polytoma*

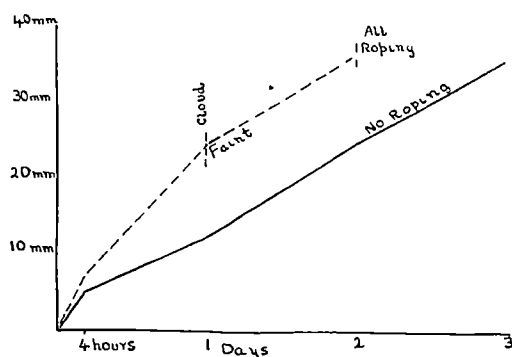


FIG 3—Climbing of *Polytoma* 'blanket' in tap water, one tube, continuous line, and tap water contaminated with stale urine at start of test, 1 per cent urine, dotted line, 0.5 per cent urine, broken line, mean from two tubes of each, deviations from mean are shown where scale permits. Temp range, 49°-57° F, 63° on second day for 2 hours.

blanket follow later and absorb its aggregation. Confusion may thus arise.

Through the courtesy of Mr J T Thompson, manager of the Leeds Sewage Works, I have been able to begin the study of this reaction under practical conditions. I have had the benefit of his expert knowledge of the processes of sewage purification, and access to the record of the analyses of the sewage and effluents tested, as done by Mr H Watson. The reaction has been demonstrated to the Royal Society of Tropical Medicine and Hygiene.

LL LLOYD

Zoology Department,  
University, Leeds

#### The Variation of Penetrating Radiation with Zenith Distance

FROM the few investigations<sup>1</sup> so far made of the angular distribution from the zenith of penetrating radiation, the only definite result which emerges is that the intensity is much greater in the vertical direction than in any other. Very recently Mr Medicus has published<sup>2</sup> the results of observations made by a method similar to mine described below. But the number of coincidences registered in the different directions is perhaps insufficient for a definite deduction. There is therefore a great need for a trustworthy series of measurements, made with an apparatus having sufficient resolving power to allow the true distribution to be deduced. An exact knowledge of this distribution is of no little importance. In the first place, it is a necessary element in the exact discussion of many other experiments. Secondly, it is interesting to see whether the observed zenithal distribution can be due to the absorption by the atmosphere of a radiation which was originally isotropic.

With these considerations in view, I have attempted a thorough investigation of the problem. I wish to express my sincere thanks to Prof B Rossi for suggesting this problem and for his advice and help.

The measurements were made in a wooden hut, the walls and roof of which were 3.5 cm thick, especially built for the purpose on a terrace of the Physical Laboratory of Arcetri, which is so located that its

horizon is unobstructed, except partially towards the east by the hill of Arcetri.

For the purpose of observing only the rays coming from a relatively small solid angle, I used the coincidence method between the impulses of two Geiger-Müller tube counters. These had a diameter of 3 cm and an effective length of 20 cm. The coincidences were registered by Rossi's method.<sup>3</sup> The axes of the two counters were placed horizontally at a distance of 18 cm apart.

The two tube counters were mounted so that the plane containing the axes of the two tubes could be rotated round a horizontal axis (the latter being exactly in the north and south direction), so as to make a varying inclination with the vertical. The observations were made with the inclination towards the west.

To eliminate the softer component of the penetrating radiation, a block of lead 5 cm thick was interposed between the two counters at a distance of 0.7 cm from the lower one. This precaution seemed advisable both because this softer radiation may very probably be partly of secondary origin and because the walls of the hut are likely to have an influence only on this softer radiation. The results are as follows:

|                                    |   |            |            |            |            |            |
|------------------------------------|---|------------|------------|------------|------------|------------|
| $\phi$                             | = | 0          | 20         | 40         | 60         | 75         |
| Coincidence                        | = | 1616       | 1441       | 1018       | 404        | 181        |
| in 17 <sup>h</sup> 20 <sup>m</sup> | = | 93.2 ± 2.5 | 83.2 ± 2.5 | 58.4 ± 2.2 | 23.3 ± 1.7 | 10.5 ± 1.4 |
| No. per hour                       | = |            |            |            |            |            |

In the first line are shown the values of the angle  $\phi$  between the vertical and the plane containing the axes of the counters, in the second the total number of coincidences observed in 17<sup>h</sup> 20<sup>m</sup> in each of these positions. The casual coincidences, amounting to 13.8 per hour, have been deducted from the above figures. Lastly, the third line shows the mean value of the number of coincidences in an hour, with the corresponding statistical error. These latter values are represented graphically in Fig 1.

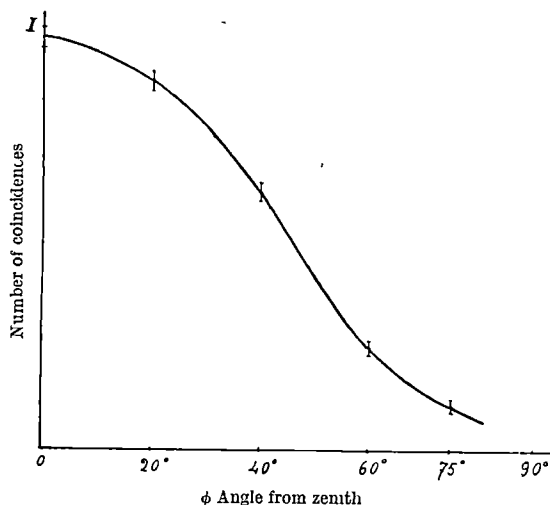


FIG 1

Without entering into a full discussion of these results, which will be described in detail shortly, I note that the intensity curve, as a function of the zenithal angle, seems to be somewhat sharper than would be expected from absorption by the atmosphere.

Finally, I wish to express my thanks to Mr L. Emo for the friendly help given me during part of these investigations, and to the Consiglio Nazionale

delle Ricerche, which has supplied the funds necessary to carry out a group of researches on the penetrating radiation

GILBERTO BERNARDINI

Laboratorio di Fisica della R Università,  
Arcetri, Firenze,  
March 5

<sup>1</sup> Tuwim, *Sitz Preuss Akad.*, p 91, 1931 Skobeltzvn, *C R*, 194, 110, 1932

<sup>2</sup> Medicus, *Z Phys*, 74, 350, 1932

<sup>3</sup> NATURE, 125, 636, 1930

### Geophysical Prospecting

MAY I, as one of the editors of "The Principles and Practice of Geophysical Prospecting" (Cambridge University Press, 1931), ask NATURE to publish the following correction? It is made at the request of Mr E H Booth, one of the contributors to the chapter on seismic methods, and it has the approval of Sir Edgeworth David

An error has crept into the discussion of field tests at Tallong, N S Wales, given on p 229 In Fig 176 the east and west indicators have been accidentally interchanged The same figure indicating the interpretation placed on the geophysical work shows the existence of a mass of alluvium over a mile wide and upwards of 200 feet deep In the geological map of the Tallong area, reproduced on p 228, no such deposit of anything approaching to this extent and thickness is shown, though the omission of a geologist to indicate such a mass of material would be very serious As a matter of fact, the deposit is mostly decomposed granite in situ The mistake in representing this as alluvium is obviously due to the fact that decomposed granite transmits seismic waves comparatively slowly, as would alluvium, namely, at the rate of about 3000 feet per second Actually there is outcropping granite over this portion of the area, as shown in the geological map The use of the term 'alluvial velocities' as a general expression for the velocity of a wave through incoherent material is apt to be misleading, and might be discontinued

In fairness to the geologists who surveyed this area years ago, it must be admitted that the geophysical interpretation, while accurately classifying the material according to the velocities of the transmitted waves, was inaccurate in its presentation of the geological structures of the Tallong area. It is regretted that through an oversight no reference was made to the fact that the geological map of Tallong, reproduced in Fig 175, is almost entirely the work of Dr W G Woolnough, geological adviser to the Commonwealth Government of Australia The accuracy of this map has been amply verified by later observers

T H LABY

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Feb 4

### Automatic Recording of Heaviside Layer Heights

EXPERIMENTS made to determine the effective height of the Heaviside layer have shown extremely varied results, and it has been clear that, in order to obtain any idea of the normal state of the upper atmospheric ionisation, it is unsatisfactory to take observations at widely spaced intervals of time Continuous automatic records of effective height are required

Gilliland and Kenrick have recently published a preliminary account of a method of obtaining such records<sup>1</sup> I have independently developed a method which differs in several important respects from that of Gilliland and Kenrick The 'echo' method of

Breit and Tuve is used A transmitter is caused to emit short 'pulse' signals with a constant interval by being driven from the A C mains The signals, together with any echoes, are then arranged to give a stationary pattern on a cathode ray oscillograph screen at the receiver<sup>2</sup> The tips of the peaks representing the signal and echoes are photographed on a film moving at about three inches per hour

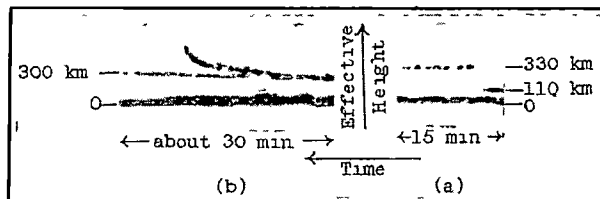


FIG 1—Specimen records of height of Heaviside layer

The sample records shown in Fig 1 have been obtained in this way, and show the following results

- (a) Jump from E layer (110 km) to F layer (330 km)
- (b) Splitting of echo from F layer The upper component apparently vanishes due to electron limitation, while the lower component persists

It is hoped to publish further details of the method in the near future

ERIC L C WHITE

Cavendish Laboratory,  
Cambridge,  
March 5

<sup>1</sup> Bureau of Standards *J Research*, Nov 1931, 783

<sup>2</sup> E L C White, "Method of continuous observation of the Heaviside Layer", *Proc Camb Phil Soc*, 27, 445, 1931

### Photo-Conductivity of Diamonds

SINCE reporting that we had found a diamond transparent at  $8\mu$  in the infra-red and so far as  $\lambda 2300$  in the ultra-violet region of the spectrum,<sup>1</sup> whereas most diamonds have an intense infra-red absorption band at  $8\mu$  and no longer transmit beyond  $\lambda 3000$ , we have come across four more diamonds of that type transparent in both regions Some of these diamonds respond to radiation in a manner which is striking and, we believe, hitherto unrecorded

Gudden and Pohl,<sup>2</sup> and also Miss Levi,<sup>3</sup> succeeded in obtaining a current when certain diamonds were illuminated with ultra-violet light from a mercury arc, provided at the same time a considerable voltage were applied to surfaces of the diamond

This we can repeat with all the diamonds of the transparent character, but most of them on illumination without the application of any voltage produce a current In one case this is as much as is equivalent to a galvanometer throw of  $1 \times 10^{-7}$  ampere, while a back E M F of about 0.6 volt is required to bring the galvanometer back to zero This effect was obtained with contacts of brass, lead, or graphite

Exploration of the activating region by means of the large monochromator of King's College, London (kindly put at our disposal by Prof Allmand), showed that the most effective wave-length for photo-conductivity in the transparent diamonds is about  $\lambda 2300$

R ROBERTSON  
J J FOX  
A E MARTIN

Government Laboratory,  
London, W C 2,  
March 24

<sup>1</sup> Robertson and Fox, *NATURE*, 126, 279, 1930

<sup>2</sup> *Z Phys*, 3, 125, 1920 6, 249, 1921 7, 65, 1921

<sup>3</sup> *Trans R S Can*, 16, 241, 1922

### The Hydrogen Chromosphere

THE slow decrease of the density of hydrogen with increasing height in the solar atmosphere requires a consideration of the force opposing gravity. As is well known, radiation pressure is insufficient for this purpose, at least if the radiation-intensity is not wholly different from the value derived by extrapolation from the solar spectrum in the visible region.

However, the existence of an outward moving stream of  $\text{Ca}^+$  atoms requires the investigation of the acceleration imparted to the H-atoms. This acceleration depends on the density  $\rho$  of the  $\text{Ca}^+$  atoms and their systematic outward velocity  $v$ . The value of the required product  $\rho v$  may be deduced from the contour-asymmetry of the K-line, as measured by Minnaert. I have derived the value<sup>1</sup>

$$\rho v = 0.8 \times 10^{-12},$$

however, owing to the circumstances of the problem, this value has a large degree of uncertainty and requires revision in the future.

Combining the determination of  $\rho v$  with a classical computation<sup>2</sup> of the effect of the collisions on the hydrogen atoms, I have deduced the ratio of the acceleration imparted to a hydrogen ion at rest to the acceleration of gravity. The resulting value of this ratio is 1.1. The value for a hydrogen atom would be much smaller on account of the shielding effected by the bound electron.

Though inconclusive at present on account of uncertainties in the values involved, this computation induces me to adopt as a working hypothesis the convection of the hydrogen atoms by the outward moving  $\text{Ca}^+$  atoms.

The fact that the motive force of the  $\text{Ca}^+$  ions only is present at comparatively great heights in the solar atmosphere concentrates its action especially on hydrogen.

A more detailed analysis of the motion of hydrogen will be published elsewhere. J. WOLTJER, JR.

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<sup>1</sup> *B. A. N.*, 182  
<sup>2</sup> *B. A. N.*, 213

### Polarisation of Raman Scattering

THE use of an improved technique has enabled us to obtain more precise measurements than formerly of the polarisation of the lines in Raman spectra. A systematic study has now been made with many liquids. An important result obtained is that no line has a depolarisation greater than 6/7, and that earlier reports by various workers indicating a larger depolarisation in certain cases are not correct. The limiting value of 6/7 is obtained in many instances, especially in all cases of a rotational scattering, whether by gases or by liquids. Many vibration lines also exhibit this high degree of depolarisation, as, for example, the frequencies 605, 1584, and 1605 of benzene, the two bands at 189 and 1398 in formic acid, the line at 750 in thiophene, the frequencies 106, 131, and 403 in tin tetrachloride, and the corresponding lines given by the tetrachlorides of carbon, silicon, and titanium. In all these cases, the explanation suggested in the last paragraph of Bhagavantam's note in *NATURE* of Jan. 30, 1932 (p. 167), is evidently applicable.

A careful determination has been made with the intense 992 line of benzene and it is found that it exhibits a genuine depolarisation of 7 per cent. The tetrachlorides of carbon, silicon, titanium, and tin exhibit an interesting progression in the behaviour of their strongest lines: the lines 459, 426, 382, and 367 given respectively by these compounds exhibiting

depolarisations of 4, 11, 12, and 16 per cent. That these lines, which correspond to a symmetric oscillation of the tetrahedral molecules, exhibit a genuine depolarisation is not surprising in view of the well-attested optical anisotropy of these molecules. It is found that the Rayleigh scattering by all the tetrachlorides is accompanied by a rotational Raman scattering and is depolarised to an appreciable extent, which increases with increasing atomic number of the central atom.

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Calcutta, India, Feb. 28

### Constitution of the Keratin Molecule

IN a note which appeared recently in these columns, Speakman and Hirst<sup>1</sup> recorded comparisons of the work necessary to stretch wool fibres in water, in acids, and after treatment with nitrous acid. The conclusion they reached was that acids disrupt a linkage of the type  $\text{R}_1 - \text{COO} - \text{NH}_2 - \text{R}_2$  in the keratin molecule formed from acidic and basic units in adjacent polypeptide chains. Taking the figures quoted by Marston<sup>2</sup> for the amino-acid composition of wool, it was shown that the dibasic aspartic and glutamic acids were collectively present in quantity roughly proportional to that required on the assumption that they entered into a linkage of the type postulated with the  $\epsilon$ -amino group of lysine and the guanidine group of arginine.

The suggestion put forward by Speakman and Hirst is worthy of consideration in explaining the properties of wool fibres, although they have neglected in their calculations one factor which makes the agreement or correspondence between the quantities not so close as would appear from their figures. They have assumed that every molecule of glutamic or aspartic acid has one carboxyl group free to enter into salt formation with an amino group. Wool yields upon hydrolysis 1.2 per cent of 'ammonia'- or 'amide'-nitrogen. Now, the general opinion among protein chemists is that this ammonia exists in the protein in the form of acid-amide linkages with one or other of the dibasic amino acids<sup>3, 4, 5</sup>.

Osborne<sup>6</sup> was one of the first to point out the parallelism between the yields of ammonia and of dicarboxylic acids from various proteins, and although hydroxyglutamic acid was only discovered afterwards,<sup>7</sup> it will be recalled that Luck<sup>8</sup> succeeded in isolating a complex from caseinogen, representing at least one-third of its ammonia nitrogen, in which a peptide of lysine-glutamic acid amide was the principal constituent. Alternative theories as to the origin of ammonia nitrogen, for example, ureide linkages,<sup>9</sup> which have at one time or another been proposed, have all had eventually to be abandoned.

Speakman and Hirst must therefore deduct 12.6 per cent by weight of glutamic acid from the 12.9 per cent contained in wool, since this is presumably in combination with the 1.2 per cent of ammonia nitrogen, leaving 0.3 per cent of glutamic acid and 2.3 per cent of aspartic acid (say 2.6 per cent in all) free to enter into the type of union they postulate with the basic amino acids. As they state, "Using Marston's data, the arginine and lysine are together equivalent to an amount of glutamic acid equal to 11.4 per cent by weight of the wool." Even if the more recent figures of Vickery and Block,<sup>10</sup> independently confirmed by Stewart and me,<sup>11</sup> of 8.6 per cent arginine instead of 10.2 per cent and 2.3 per cent lysine instead of 2.8 per cent, be taken, these bases, for complete combination, would require 9.57 per cent of glutamic acid—nearly four times the amount actually available.

So far, no systematic search has been made for

hydroxyglutamic acid or for hydroxylysine in wool, and the above considerations are naturally confined to existing data

A second point in the communication under consideration raises the question whether hydroxylysine may not be a constituent of wool. Speakman and Hirst found 0.94-1.11 per cent of amino nitrogen in the wool they examined, the  $\epsilon$ -amino groups of 2.8 per cent lysine would account, however, for only 0.27 per cent. They included 0.82 per cent as being derived from 10.2 per cent of arginine, making 1.09 per cent in all, in agreement with their experimental findings. The guanidine group of arginine does *not*, however, yield nitrogen with nitrous acid under the usual conditions.

Van Slyke and Birchard<sup>12</sup> have shown that in most proteins the free amino nitrogen corresponds very closely to one-half of the lysine nitrogen, and in the present case it may be concluded that wool probably contains hydroxylysine or other diamino acid in addition to lysine.

Our uncertainty as to the composition of the keratin molecule (only one complete analysis is upon record, that of Abderhalden and Voitnovici<sup>13</sup> in 1907) makes it imperative that trustworthy quantitative chemical evidence should be available to test the newer physical theories of keratin structure now being advanced.

CLAUDE RIMINGTON

Onderstepoort Veterinary Research Laboratory,  
Pretoria, South Africa, Feb. 1

<sup>1</sup> Speakman and Hirst, *NATURE*, 128, 1073, Dec. 26, 1931.

<sup>2</sup> Marston, Council of Sci. and Ind. Res., Commonwealth of Australia, *Bulletin*, 38, 1928.

<sup>3</sup> Fischer, "Untersuchungen über Aminosäuren, Polypeptide und Proteine", 1, 1899-1906, 2, 1907-1919. Springer, Berlin.

<sup>4</sup> Osborne, *J. Amer. Chem. Soc.*, 24, 140, 1902.

<sup>5</sup> Osborne and Gilbert, *Amer. J. Physiol.*, 15, 333, 1905-1906.

<sup>6</sup> Osborne, Leavenworth and Brautlecht, *Amer. J. Physiol.*, 23, 180, 1908-1909.

<sup>7</sup> Dakin, *Biochem. J.*, 12, 290, 1918.

<sup>8</sup> Luck, *Biochem. J.*, 18, 679, 1924.

<sup>9</sup> Andersen and Roed-Müller, *Biochem. Z.*, 70, 442, 1915.

<sup>10</sup> Vickery and Block, *J. Biol. Chem.*, 86, 107, 1930.

<sup>11</sup> Stewart and Rimington, forthcoming publication in *Biochem. J.*

<sup>12</sup> Van Slyke and Birchard, *J. Biol. Chem.*, 16, 539, 1913-1914.

<sup>13</sup> Abderhalden and Voitnovici, *Z. physiol. Chem.*, 52, 368, 1907.

### Preparation of Anhydrous Chlorides and Metallic Couples

DURING investigations involving the Grignard reagent it was noticed that, when the magnesium was in contact with lead chloride under ether, bubbles of gas were evolved, which were found to arise from traces of water in the ether.

This led to the investigation of the action of water on a metallic salt (chloride, sulphate, nitrate, etc.) when mixed with a metal lower in the electropotential series than the metal of the salt.

It was found, especially in the case of the chloride, that reaction in many cases occurred with explosive violence, the more electro-positive metal replacing the less electro-positive metal of the salt. Typical cases of such violent reactions were given by zinc and aluminium respectively when in contact with (a)  $\text{HgCl}_2$ , (b)  $\text{PbCl}_2$ , (c)  $\text{Cu}_2\text{Cl}_2$ , etc. Such mixtures are very effective for detecting the presence of traces of water in organic liquids.

These observations led to heating the mixtures to ascertain whether in cases of volatile chlorides a simple method of preparation were possible, and it was found that when excess of aluminium was heated with lead chloride a quantitative yield of aluminium chloride was obtained. When excess of aluminium is not taken, a yellow crystalline substance (probably a double chloride of lead and aluminium) is formed along with the aluminium chloride. The reaction takes place very readily and can be carried out in a

soft glass test-tube. Aluminium and cuprous chloride, also aluminium and silver chloride, react easily to give aluminium chloride. For syntheses by the Friedel Crafts' reaction, the aluminium chloride can be quantitatively distilled over by connecting the test-tube with a bent metal tube to the reaction vessel. Instead, the mixture may be placed in the reaction vessel itself and gently warmed, the aluminium chloride condenses on the side of the flask, and the metallic residue can be shaken out of the vessel. The chloride is then washed down the side of the vessel with the organic solvent, or dislodged by means of a glass rod.

Zinc and stannic chlorides are readily prepared by the action of (a) zinc on cuprous chloride, (b) tin on cupric oxychloride. The cupric oxychloride is prepared by fusing ordinary hydrated cupric chloride on a tray, the fused mass being ground up in a mortar and transferred to a distillation flask. Powdered tin is dropped into the flask, the neck being closed by a cork wrapped in tin-foil. On gently heating, anhydrous stannic chloride distils over and is collected in a test-tube placed on the side arm. In this way anhydrous stannic chloride in excellent yield can be very quickly prepared.

Zinc and cuprous chloride when left on a filter paper react, causing the paper to ignite. When magnesium and cuprous chloride were heated together an explosion occurred, the flask was shattered and coated with copper.

Another point of interest is that effective couples can be made in this way. For example, in the preparation of diphenyl methane,<sup>1</sup> instead of adding aluminium mercury couple, an effective nascent couple is obtained by adding a little aluminium and mercuric chloride. The yield was quite as good as that obtained by the usual method, with the further advantage that the couple prepared in situ is always effective, and is more certain in its action than the ordinary couple.

Observations indicate that oxychlorides may in some cases be better than normal chlorides, for the use of the former involves the possibility of a thermite as well as a displacement reaction.

At present the application of the above facts for widening the scope of reactions is being investigated.

S. D. NICHOLAS

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University of Birmingham,  
Edgbaston, Feb. 23

<sup>1</sup> Cohen, Hirst, *Trans. Chem. Soc.*, 67, 826, 1897.

### Degree of Weathering of Soils

IN the modern study of soils, there is an urgent need for methods of analysis which will express quantitatively the fundamental properties and genetic relationships of the material examined. We are venturing to suggest a provisional method whereby an approximate estimate may be obtained of the extent to which chemical weathering has proceeded in a given soil.

Assuming that the clay fraction separated in mechanical analysis represents that portion of the soil which has resulted from processes of chemical weathering—the so-called weathering complex—and that the remainder of the soil consists of unweathered minerals, such as feldspars, and unweatherable minerals, such as quartz, the proportion of the total alumina of the soil present in the clay fraction should give a rough measure of the degree to which chemical weathering has proceeded. Since the principal clay-forming minerals are complex aluminosilicates, a soil which has reached the end-point of weathering

will contain no alumina in its non-clay fraction. On the other hand, a soil in the early stages of chemical weathering will contain considerable amounts of alumina as unweathered aluminosilicates in the non-clay fraction. We therefore propose, as a measure of the degree of weathering, the amount of alumina in the clay fraction, calculated as a percentage of the total alumina of the soil. For example, if a certain soil contains 20.5 per cent of alumina, of which 16.4 per cent is in the clay fraction, the degree of weathering is 80 per cent. A parallel estimate may be obtained from the percentage of the total ferric oxide of the soil present in the clay fraction, but in many cases, particularly in tropical soils, there are considerable proportions of secondary ferric oxide in the non-clay fraction. Indeed, with lateritic soils, the partition of alumina is equally untrustworthy as a measure of the degree of weathering.

We have divided the soils examined by this method into two categories, namely, (1) soils derived by primary weathering from crystalline rocks, and (2) soils derived from materials such as alluvium and marine sediments which have already undergone one or more cycles of weathering. In Category 1, we may distinguish (a) soils such as those in Britain, in which chemical weathering has only proceeded to a moderate extent, and (b) soils of the humid tropics, in which chemical weathering is far advanced.

We have examined five soils in Category 1 (a), six soils in Category 1 (b), and seven soils in Category 2. Our results are shown in the following table, which gives the average degree of weathering calculated from the alumina and from the ferric oxide data respectively.

|                | Degree of Weathering calculated from |                                |
|----------------|--------------------------------------|--------------------------------|
|                | Al <sub>2</sub> O <sub>3</sub>       | Fe <sub>2</sub> O <sub>3</sub> |
| Category 1 (a) | 33.0 (18.6-40.3)                     | 32.1 (15.5-43.1)               |
| Category 1 (b) | 76.5 (58.4-89.7)                     | 66.1 (58.6-94.3)               |
| Category 2     | 82.9 (70.5-93.4)                     | 64.5 (48.5-84.3)               |

It will be seen that the figures obtained are in good agreement with expectation, for the tropical soils and the soils of secondary origin show much higher degrees of weathering than the relatively immature soils derived by primary weathering under British conditions. The degrees of weathering calculated from the ferric oxide data are in the same order as those calculated from the alumina, but are rather lower, partly on account of the presence of ferric oxide of secondary origin in the non-clay fraction, and partly on account of the presence, in some cases, of unweatherable minerals of the magnetite group.

Though only approximate in character, the proposed method may serve as a simple procedure for obtaining an estimate of the relative maturity of soils, and may, therefore, aid in the sub-classification of the major soil groups. It may also find an application in the study of regolithic materials.

G. W. ROBINSON  
MINNIE RICHARDSON

University College of North Wales,  
Bangor, March 3

#### Function of the Spiracles of Insects

In carrying out investigations on the respiration of insects, with particular reference to the action of the spiracles and the factors which control their activity, one is struck by the divergence of the results recorded by previous workers. It appears that they have tended to look upon the spiracles only in connexion with gaseous exchange (oxygen and carbon dioxide). Respiration, however, also entails a water metabolism.

Feeling that the tracheal system may have an importance hitherto overlooked in the water balance of the insect, both in respiration and temperature control, efforts have been made to assess the various avenues of water exchange, using larvae and pupae of *Galera mellonella* (Lepidoptera). Preliminary experiments show that a large part (a first approximation gives 50 per cent of total) of the water exchange occurs via the trachea and spiracles.<sup>1</sup>

The results obtained may help to explain the different observations upon spiracular behaviour at increased temperature. Thus, while at one time the spiracle may be opening to deal with an increased gas exchange at increased temperature, it may later begin to close to avoid injurious desiccation.

The problem is complicated by the increase in the rate of gaseous diffusion at high temperatures, which tends to overcome the need of spiracular opening. The experiments performed, however, give generally concordant results and uphold the idea put forward very well. The technique is simple and allows of concurrent observations on the localisation of carbon dioxide exchange, and it is hoped to shortly publish a full account of the results.

T. L. GREEN

Department of Zoology,  
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London, S.W. 7, March 17

<sup>1</sup> Buxton, 1930. *Proc. Roy. Soc. Lond.*, B, 106

#### Preparation and Mounting of Deliquescent Substances

CERTAIN deliquescent crystals were required for structural investigations. The following method of preparation and mounting was found satisfactory.

A tube 1.5 cm. in diameter was drawn down at one end to a short tube 0.75 cm. across, and at the other to a capillary. The apparatus was warmed and a stream of dry carbon dioxide was passed through from the capillary end. When the apparatus was dry, the substance to be sublimed was introduced, the gas flow stopped, and the end of the narrow tube sealed. The capillary was then attached to a 'Hyvac' pump, the apparatus evacuated and sealed off.

The tube was heated in an air oven until good crystals were obtained. When cool, a scratch was made at the base of the narrow tube, and a piece of thin rubber tubing was slipped over it until it gripped the wide tube. The rubber tubing was connected to the supply of dry carbon dioxide. The tube was then broken at the scratch, thus filling the apparatus with dry gas. The broken glass was pushed down the rubber tubing until a sufficient length was free to be clipped. The end was then cut off, and a piece of lithium glass tube, drawn down to a capillary at one end, was inserted, carbon dioxide being passed meanwhile. The capillary was then sealed and the clip removed. A piece of stout wire was pushed through the rubber and used to dislodge the crystals, one at a time. After dropping into the capillary tube, they were sealed off separately. The crystals are liable to move unless the tube tapers.

Slight changes in technique enabled crystals grown from solution or fusion to be mounted in the same way.

When optical measurements were to be made, the crystal was dropped into a small spherical bulb blown on the end of a short tube. A fine glass rod dipped into tap fat was passed through the hole in the rubber, and the crystal, suitably oriented, was picked up on the end of this. The rod was then melted into the side of the tube, and the whole sealed off.

NORA WOOSTER  
A. J. P. MARTIN

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The Museums, Cambridge, Feb. 23



## Research Items

**The Campas Indians, East Peru**—Some notes on the culture of the Campas Indians of eastern Peru are given by Prof Morris G Caldwell and Mr John Calhoun in the *Scientific Monthly* for March. An area covering several thousand square miles of jungle and mountainous land and intersected by several tributaries of the upper Amazon is characterised by a common culture sufficiently uniform to justify the name of 'the Campas Culture-area'. It extends from the Pachitea River south to the Mantaro, and from the Ucanah westward to a line from Jauja to Huanaco. The Indians possess a well-developed culture, though it appears to be retarded. They use bamboo arrows three feet long, tipped with a sharpened palmwood head sixteen inches long. Four small prongs encircle the point to catch in the flesh. Blunt hardwood heads are used for killing small birds. Fish arrows have three prongs. The bow is of palmwood five feet long. A hunting axe of dull porous stone hafted on a two-foot wooden handle is used. The principal means of transportation is by canoe—a dugout about thirty-five feet long and five feet wide. It is made from palmwood by the use of axe and fire. Pottery jars are made from the yellow river clay; they are used for carrying water, fruit berries, etc. Garments are made from cotton which grows wild, and are often decorated with feathers, bunches of bone, seeds, nuts, toes of small animals, and bones of small birds and monkeys. The dress is a slip-over garment without sleeves and a poncho. They chew coca leaf and have an intoxicating liquor made from yucca root chewed by the old women.

**Egyptian Magic**—An Egyptian bilingual papyrus, long in the British Museum but unknown to scholars, has been translated and edited by H I Bell, A D Nock, and Herbert Thompson (*Proc Brit Acad*, vol 17). It gives a number of short magical formulæ current in Egypt, presumably at the date of writing, which is placed at somewhere towards the end of the third century A D. The procedure is usually to invoke a god or some higher power and compel him to assist the invoker in procuring what he wishes. In the present collection the Demotic text includes an invocation to Thoth for aid, a method to discover a thief, spells for reputation, and an amatory spell. The Greek texts are mainly concerned with the last named. In a spell to obtain an answer to a dream, a laurel leaf is placed under the head when the invoker goes to sleep. On it are written seven invocations, that is, seven strange forms of the names of Horus and Thoth, to which *kh* has been added, possibly representing some peculiarity in pronunciation of the divine name. In "the way of finding a thief", the head of a drowned man is used, a stalk of flax grown from the ground under which it has been buried for the purpose, being used to tie the magical knot which binds the thief. In a charm to win a woman's love, a figure of Osiris in wax, wound in ram's wool, is buried with the bone of a lizard under her threshold, while a spell is chanted to Isis at the rising of the moon. The influence of the lizard is seen again in a charm in the Greek text, of which the object appears to be to secure the woman's love by ensuring her separation from her husband. Numerous examples of the use of the lizard in medicine and erotic magic are collected in the editorial notes.

**Flocking Habits of Birds**—The use of bird-ringing (or banding, as it is called in America) in conjunction with bird traps has brought to light some interesting features regarding the grouping of birds during the

winter or non-breeding season. On the campus at Stanford University, California, flocks of golden-crowned and white-crowned sparrows (*Zonotrichia coronata* and *Leucophrys pugetensis*) arrive on autumn migration or stay over the winter until the return in April and May. To supplement the ringing method, which entails the handling of birds for identification, some feathers of the birds were distinctively stained so that the individuals could be recognised in the field. The results, recorded by John B Price (*Condor*, 1931, p 238), show a constant return of the same bird to the same area and even the same trap. The author concludes that both species spend the winter in definite flocks, each with its own range of 15-20 acres. Between the flocks there is very little interchange of individual birds, and the memory of the territory seems to persist from year to year, for in most cases an individual bird was found to return to its original flock territory after migration.

**Classification of the Gulf-Weeds**—On British coasts' the most conspicuous of the brown seaweeds are members of the group Fucales, represented by a few genera, each with one or only few species, the commonest being *Fucus* spp. In warmer seas, the group is also prolific, but represented by other genera, of which one of the more important is *Sargassum*. Unlike *Fucus*, *Sargassum* is represented by a large number—probably more than three hundred—of species, and a wide field is still open to systematists to bring the classification of this genus into a satisfactory condition. Problems are presented not only by the large number of species, but also by variations in form due to environment and to the fact that some of the species are dioecious, with morphological differences between plants of the two sexes. Dr Setchell of California has given an account (*Hong Kong Naturalist*, vol 2, No 4, 1931) of the existing schemes of classification and the main features of the five subgenera, based on the system of J C Agardh (1848-1889). He adds also a tentative artificial key for the identification of species occurring in the Hong Kong region, where the genus is well represented. This should prove of great assistance to any who have opportunities of studying the genus further.

**Maize Hybrids with *Tripsacum***—Induced parthenogenesis is a possible method of obtaining homozygous strains instead of prolonged inbreeding. Mangelsdorf and Reeves (*J Her*, vol 22, No 11) attempted to produce such seeds in maize by pollinating it with a related grass, *Tripsacum dactylodes*. This species extends from the Atlantic to Texas, the Texas form used having narrower leaves and  $2n=36$  chromosomes, while the Connecticut form has  $2n=72$ . Crossing with the Texas type was obtained by shortening the maize silks or stigmas to about two inches. By double pollination it was found that hybrid seeds develop better adjacent to normal seeds. No parthenogenetic embryos were obtained, but the hybrid seeds usually showed 38 chromosomes. In maize  $n=10$ , so with double fertilisation an endosperm containing  $10+10+18$  chromosomes should be found. The embryos of these seeds usually had 28 chromosomes. When pollen from the tetraploid *Tripsacum* was used, seedlings were obtained with 46 chromosomes in their root tips, as expected. Most of the seeds in these crosses were abortive and shrivelled, but could be germinated on agar. From some 185,000 silks exposed to pollination, only 84 seeds matured. Certain maize varieties crossed more

readily than others, and curiously enough the tetraploid *Tripsacum* was more successful than the diploid as pollinator. The hybrids more nearly resemble the male parent, especially when the tetraploid form is used. Some plants from this cross which matured are sterile in pollen and seeds. Meiosis shows 18 bivalents, presumably the *Tripsacum* chromosomes pairing with each other, and 10 lagging maize chromosomes. Numerous small nuclei are formed, resulting in aborted pollen. The reciprocal cross, *Tripsacum* × maize, has never succeeded. These results differ in some respects from earlier work of Collins and Kempton.

**Magnetic Distribution in China and Tibet**—In *Veröffentlichungen d. Preuss. Meteorolog. Inst.*, No 379 (Abh. Bd 9, No 7), Berlin, 1931, O. Venske gives a reduction and discussion of the terrestrial magnetic observations made by W. Filchner on his expedition through China and Tibet in 1926–28. Prior to this journey, very little was known about the magnetic distribution in Tibet. Filchner measured the declination, dip, and horizontal force at about 150 stations, about 50 km apart, using a magnetic theodolite, the dip being measured with the aid of soft iron induction bars. The stations lay on two routes, each lying roughly in the east-west direction, the northern one was from Tashkent (41° N, 69° E) by Tihua (44° N, 88° E) and on to Lussar (36° N, 102° E), and the southern one from Lussar to Leh (34° N, 78° E) over the Tangle Pass, 15,000 ft above sea-level. Despite many difficulties and privations, due to ill-health and Tibetan hostility, Filchner's measurements, according to Venske, are of satisfactory accuracy. The declination nowhere differed much from 0°, confirming that the agonic line runs east-west in Tibet, local disturbances are small and suggest (in agreement with gravity data) that the non-magnetic surface rocks reach down to great depths.

**Spitsbergen Geology**—D. Sokolov and W. Bodylevsky (*Skrifter om Svalbard og Ishavet*, 35, pp. 151, pls. 14, 1931) describe the Jurassic and Lower Cretaceous faunas of the west coast of Spitsbergen and discuss their stratigraphical relationships. The horizons which have been recognised from palaeontological evidence range from Upper Callovian to Lower Aptian. Lower Callovian and Albian may also possibly be present in Spitsbergen. The Lower Aptian does not appear to have been previously recognised in the Arctic region. Typical Oxfordian is not present. The abundance of *Aucella*, of which about thirty species are described in this memoir, gives a characteristic aspect to the Upper Jurassic and Lower Cretaceous faunas and recalls that of Petschora-land. Continental conditions are indicated by the occurrence of *Ginkgo* and other plants in beds above the undoubted Valanginian and below the *Crocera* beds of the Lower Aptian.

**Atmospheric Ozone**—The main conclusion reached by D. Chalonge in his paper (*J. Phys.*, January) on the vertical distribution of ozone in the air, is that little is known about this, and that the present methods of investigation based on ultra-violet spectrophotometry are unsatisfactory. In particular, he shows that it is misleading to refer to an absorbing layer at 50 km, if this is taken to mean that the region where absorption occurs is restricted, or even that the centre of gravity of the ozone is defined by it. Ozone is, on the contrary, present in considerable quantity so low as 20 km, and, probably with a concentration increasing with height, up to 80 km, which is not much below the Heaviside layer. What appears to be most urgent is some entirely new

experimental method, if this can be devised, and, until this is forthcoming, ambiguity is likely to attach to the results obtained with current methods, including the one which makes use of ozone absorption in the yellow, which has recently been described by O. R. Wulf (*Smithsonian Misc. Coll.*, vol. 85, No. 9).

**Optical Glasses**—As the result of an examination of the properties of a large number of optical glasses as given in a manufacturer's catalogue—that of the Parsons' Optical Glass Company—Mr. T. Smith, of the Optics Department of the National Physical Laboratory, has come to the conclusion that a knowledge of the refractive indices of a glass for light of three wave-lengths is sufficient to enable the index for any other wave-length within the visible spectrum to be calculated. The refractive index for any wave-length can be expressed in the form  $a + bw^n$  where  $a$ ,  $b$ , and  $n$  are constants for each glass and  $w$  is the wave number, that is, the reciprocal of the wave-length. From this it follows that between the indices and wave numbers for three lines we have  $(\mu_1 - \mu_3)/(\mu_2 - \mu_3) = (w_1^n - w_3^n)/(w_2^n - w_3^n)$ , and if  $n$  is found so that the equation is satisfied for three lines for which the  $\mu$ 's are observed the  $\mu$  of any other line of known  $w$  may be calculated. It is therefore more convenient to define the reciprocal dispersion or constringence  $\nu$  as  $(\mu_F - 1)/(\mu_F - \mu_C)$  where  $F$  and  $C$  are the blue and red hydrogen lines, and in comparing glasses it is more useful to the computer of optical systems if  $\log \nu$  instead of  $\nu$  is plotted against  $\mu$ , and Mr. Smith hopes glass makers will publish diagrams of this kind on an agreed uniform scale in their catalogues. He considers that at present a larger variety of glasses is produced than is necessary for optical purposes. His conclusions were well received at a meeting of the Optical Society in February, 1931, and his paper and the discussion on it appear in part 3 of vol. 32 of the *Transactions* of the Society.

**Crystal Structure of Benzene**—It is somewhat surprising that although benzene is one of the simplest of organic compounds, yet its crystal structure has never been at all fully worked out. It is true that the dimensions of the unit cell have been determined consistently in two different investigations, and that the space group and the number of molecules to the cell are known, but there are various technical difficulties which make it difficult to proceed further. Some account of these, and of the way in which they have been partially overcome, has been published by E. G. Cox (*Proc. Roy. Soc.*, March). One of the major difficulties is the high vapour pressure of benzene, which is five times that of ice at 0° C, and makes it impossible to keep the solid in the open for long. To overcome this, the crystal was enclosed in a gelatin capsule, this was reasonably transparent to X-rays, and sufficiently impervious to benzene vapour when lightly coated with shellac for the crystal to be kept for several days. It was, however, still impracticable to work with an ionisation spectrometer, and hence the rotating crystal method, with a special cooled camera, had to be employed. Even so, it was not considered worth while to make other than eye estimates of intensity. The main result which emerges is that the experimental results are strongly in favour of a flat-ring molecule, a puckered ring would exaggerate some of the discrepancies observed, and would not agree with the absence of cleavage of the crystals and their considerable hardness. Beyond this, little more can be said than that the ring structure is loosely knit, the average distance from centre to centre of carbon atoms in neighbouring molecules is

about 3.8 Å, compared with 3.5 Å, which is the distance most usually found to occur in organic substances

**Reactivity of Metals with Water**—We have received from Mr. Binayendra Nath Sen, of 57 Patu-atola Lane, Calcutta, a communication in which he advances a rule that only those metals react with water at the ordinary temperature in which the distance of closest approach of the atoms is not smaller than 3.00 Å. The list includes lithium, sodium, potassium, calcium, bismuth, magnesium, cerium, and lead. Mr. Sen states that other metals are not acted upon by water at the ordinary temperature, and in them the distance of closest approach is less than 3.00 Å, with one or two exceptions.

**Oxidation of Phosphorus**—A number of new observations on the oxidation of phosphorus vapour at low pressure, which bring out the fact that this can occur in more than one way, have been described by H. W. Melville and E. B. Ludlam (*Proc. Roy. Soc., March*). They are concerned with the manner in which the reaction takes place in the presence of tungsten and platinum when the pressure is too low for an explosion, but in order to avoid the difficulties which arise in applying the usual methods for measuring low pressures in this instance, the explosion limit was made use of for this purpose by determining how much additional oxygen was required to pass to the critical value for explosion to occur. When platinum was put in the reaction chamber, the rate of reaction could be measured conveniently with it at 200° C, no glow could be seen during the reaction, and it

probably occurred at the platinum surface. With a tungsten filament, on the contrary, it was necessary to go to 500° C, and the reaction was accompanied by a green glow, from this, and from other evidence, it was concluded that the change started at the metal surface, but was propagated through the gas, and finally ended on the walls of the tube. Gold, silver, and molybdenum, although not studied in detail, appeared to behave similarly to tungsten.

**Pressure on Retaining Walls**—A paper was read before the Institution of Civil Engineers on Feb. 23 by Prof. C. F. Jenkin on "The Pressure on Retaining Walls." Researches on this subject were begun by the author in the Engineering Laboratories at Oxford in 1926, and during the last two years have been continued at the Building Research Station. An account of the work up to last year was given by Prof. Jenkin to the Royal Society, but the present paper describes the latest type of experimental apparatus and gives the results of tests on the pressure exerted by sand on walls of many types. The tests include measurements of the forces on the wall (in magnitude, direction, and position) and also the determination of the planes of rupture and the nature of the motion of the sand down the back of the wall. Approximate formulæ have been developed and their application is summarised in practical working rules. The errors in many of the old forms of wedge theory are pointed out, the reaction of the wall on the sand is discussed, and the author expresses the hope that others may be saved from the pitfalls into which he himself has fallen.

### Astronomical Topics

**New Comet**—Two telegrams and circular No. 361 from the I. A. U. Bureau, Copenhagen, announce the discovery of a comet of the ninth magnitude by Mr. H. E. Houghton (presumably at Pretoria) on April 1. It was observed at the Cape observatory as follows: April—2<sup>d</sup> 18<sup>h</sup> 0<sup>m</sup> U. T., R. A. 13<sup>h</sup> 39<sup>m</sup> 16<sup>s</sup>, S. Decl. 75° 50', daily motion, -6<sup>m</sup> 0<sup>s</sup>, N. 1° 26'. No orbit is to hand, but the rapid northward motion may bring it into the view of European astronomers before very long. Actually the U. T. of the above observation was given as 6<sup>h</sup>, but as there was daylight at the Cape at that time, it is presumed that 18<sup>h</sup> was meant.

There is some doubt as to the letter that should be assigned to this comet. Nothing more has been heard of the object reported by Prof. van Biesbroeck on March 6, also, the status of the Delporte object of March 12 is still in doubt—it may be either a comet or a planet.

The comet Grigg-Skjellerup should now be within reach of moderate telescopes, the following ephemeris for 0<sup>h</sup> is from *B. A. A. Circular*, No. 111.

| April 15 | R. A. 6 <sup>h</sup> 23 <sup>m</sup> 6 <sup>s</sup> | N. Decl. 2° 10' |
|----------|-----------------------------------------------------|-----------------|
| " 20     | 6 33 54                                             | 4 5             |
| " 25     | 6 46 0                                              | 6 17            |
| " 30     | 6 59 42                                             | 8 52            |

The comet is likely to be large and diffused.

**Brazilian Tide Tables for 1932**—These tide tables were calculated at the Observatory of Rio de Janeiro, with the aid of a Kelvin tide-predictor, and are published by the Brazilian Ministry of Education. They give the times of every high and low water throughout the year for the fifteen principal ports of Brazil, also the height of water above the zero marks on the tide gauges at the ports. The marked differences between the heights of the tides at the different ports are of interest. The range appears to be smallest at Rio de Janeiro, where the range at the highest springs

scarcely exceeds a metre. The port of St. Luiz is at the other extreme, on April 21, which is the highest tide of the year, the range from high to low water is 5.8 metres. Some of the ports show a considerable diurnal term, by comparison between the two high waters twelve hours apart. There is much in the book that will interest students of the tides, their astronomical interest has increased since it was shown by Taylor and Jeffreys that tidal friction is probably sufficient to explain the excess of the moon's acceleration over that arising from astronomical causes.

**The Delporte Object**—The determination of an elliptical orbit for this object from the early observations presented difficulties, owing to the object being nearly in opposition to the sun. It is unlikely that the orbit is really parabolic, but the following parabola, by S. Arend of Uccle, represents the observations with fair accuracy up to the end of March, the observed declination is then 3' north of the predicted one.

$$\begin{aligned} T &= 1932, \text{ April } 4 \text{ } 0284 \text{ U. T.} \\ \omega &= 25 \text{ } 662^{\circ} \\ \Omega &= 171 \text{ } 694 \\ i &= 20 \text{ } 137 \\ q &= 1 \text{ } 16335 \end{aligned} \quad \left. \vphantom{\begin{aligned} T \\ \omega \\ \Omega \\ i \\ q \end{aligned}} \right\} 1932 \text{ } 0$$

The following recent observations made at Uccle are published in *R. I. Circ.* 584.

|                 | R. A. 1932.0                                                   | N. Decl.      |
|-----------------|----------------------------------------------------------------|---------------|
| March 23 812165 | 13 <sup>h</sup> 26 <sup>m</sup> 7 <sup>s</sup> 16 <sup>s</sup> | 20° 55' 27.8" |
| " 26 976600     | 13 53 42 37                                                    | 25 32 6.1     |
| " 28 914416     | 14 10 32 39                                                    | 28 0 28.6     |

Uccle positions of March 23, 24, and 25, previously published, were erroneous, belonging to a different object. The Delporte object was photographed at Heidelberg on March 26, the magnitude being 14. It was noted as doubtful, but is confirmed by the Uccle observation.

### The Wheat Problem

THE Twentieth Report of the Imperial Economic Committee, originally intended for presentation at the Ottawa Conference in 1931, which was eventually postponed, has been issued in the form of a survey,\* without recommendations, of the present wheat position, with an analysis of the chief causes—economic, technical, social, and political—contributing thereto, together with indications as to which are in all probability temporary and which of a more permanent character. The fact that over vast areas of land the growing of wheat, the primary foodstuff of the world, does not repay the cost of production is a problem of the first magnitude for the Empire and for the world in general, and it is evident that such a situation has been brought about by the interaction of a number of complex causes.

In the report a statistical treatment is made of the changes in price, production, acreage, yield, and international trade that have taken place since 1920, special attention being paid to the later years of the period. Figures for Russia are excluded on account of their uncertainty and the exceptional position occupied by Great Britain during the years under consideration.

Since 1921 the trends of prices of wheat and general commodities have been very similar, this suggests that the changes in wheat prices are not solely attributable to causes peculiar to wheat production or marketing. Production, although in excess of effective demand in recent years, is actually lower than that normally expected from the pre-War trend, so that the term 'over-production' is a relative one only. The re-entry of Russia into the export trade, however, has done much to intensify the disparity between supply and demand. As a result, at the end of the crop year 1930-31, curtailment in wheat production was taking place in all the principal

exporting countries except Canada and Russia. The expansion which had occurred during the previous nine years was due to an increase in area harvested, rather than to any changes in the average yield per acre, which for the world as a whole has not shown much variation. Biological and, particularly, mechanical improvements in the methods of wheat production during the post-War period have had far-reaching economic consequences, for the result has been an increased output at a lower cost of production of a commodity for which a corresponding increase in consumption was not obtained.

Comparison is made between the policies adopted by certain important exporting and importing countries, and, almost throughout Europe, State action has been taken with the view of raising internal wheat prices in the interest of local producers. The most significant and, at the same time, the most uncertain feature of the present situation, however, is Russia. The existence of a wheat-producing country and potential exporter of the magnitude of Russia, the policy of which is not directly related to the international level of wheat prices, introduces completely new economic considerations into the question and complicates the task of assessing the world's situation.

The outlook for the season 1931-32, as summarised by the International Institute of Agriculture, indicates that the total world's production, including Russia, is, on the whole, insufficient to cover the requirements of consumption, so that it will be necessary to draw upon the accumulated stocks which continue to depress the market, but, nevertheless, it is estimated that they will still remain heavy at the end of the current crop year.

The wheat problem is, however, fundamentally a general problem, and the removal of the obstacles which to-day impede the recovery of industrial life would go a long way towards bringing about an improvement in the wheat situation.

\* Reports of the Imperial Economic Conference. Twentieth Report. The Wheat Situation, 1931. Pp 121. (London: H.M. Stationery Office, 1932.) 6d net.

### Recent Excavations in British Honduras

THE report of the first and second Marshall Field Archaeological Expeditions to British Honduras serves to point the moral that, in archaeological investigation, it by no means follows that the outstanding site or the sensational discovery in the long run makes the most illuminating contribution to knowledge of the culture of the people under investigation.

The settlements explored by these expeditions in 1928 and 1929 were situated in a peripheral area of Maya culture, in which neither exceptional development nor an advanced standard in the arts of life could be expected, while in themselves they were not of sufficient importance to justify inclusion even in the rank of fourth class sites. Yet, being in part residential, they give a truer view of the life and customs of the people than do more imposing ceremonial centres. The material they have yielded will constitute a considerable contribution toward what is much needed, namely, the formulation of an ordered sequence of pottery types and styles within a defined cultural area, which will serve as a basis for systematic and intensive study of the cultural history of circumjacent regions in an ever-widening circle. Toward this a beginning has now been made in the investigations undertaken, or projected, by the Carnegie Institu-

tion of Washington at Uaxactun (Guatemala) and the Field Museum of Chicago in north-central Honduras.

The sites investigated by the two expeditions, of which Mr. Eric Thompson was the leader, are situated in the Cayo district of British Honduras, on the western frontier, where it borders on Guatemala. The actual site of the excavations was twenty-five miles south-east of the town of El Cayo in the neighbourhood of the Mountain Cow Water Hole. Except for a scarcity of water, the site was admirably adapted to Maya settlement, having an abundance of game and a salubrious air owing to its height. In fact, these settlements are the highest cities in the 'Old Empire' area, Hatzcap Ceel, described in this report, being probably as much as 2250 ft. above sea-level. The country being very broken, the inhabitants were practically cut off from cities to the south, such as Pusilha and Lubaantun, though only forty miles away. To the west and north-west—to Ixkun, about thirty-three miles, and Ucanal, twenty-seven miles away—the country was easily traversed. Although it is not known with certainty which tribes inhabited this area when the Spaniards came, it is probable either that they were Mopans, who are known to have occupied the country immediately to the west, or were closely allied to that people. It is suggested tentatively that in ancient times these Mountain Cow Water Hole area cities were inhabited by Chol-speaking Mayas.

\* "Archaeological Investigations in the Southern Cayo District, British Honduras." By J. Eric Thompson. Field Museum of Natural History, Publication 301. Anthropological Series, vol. 17, No. 3.

Four groups of sites within a two-mile radius of the Mountain Cow Water Hole area were excavated. Of these, two, Hatzcap Ceel and Cahal Pichik, were ceremonial centres and two, Tzimin Kax and Cahal Cumil, were residential sites.

The two ceremonial centres flourished at the close of Cycle 9 and the beginning of Cycle 10 in Maya dating. Evidence for this is afforded by two dated monuments, of which the dates correspond to A.D. 835 and A.D. 910. There is evidence also of a succession of construction periods in the superposition of buildings, though not all these must be taken to represent distinct culture phases. The pyramids were found to be in a collapsed condition. Each of the ceremonial sites possibly had a ball court between two pyramids. Most of the pyramids of the temple type yielded votive caches. The contents of these caches were generally uniform in character, seven of the ten found containing characteristic small figurines of jade, slate, or shell. Other offerings were jade and small objects, including a worked flint of eccentric form with three arms, or points, two lobster-claw-shaped and one tau-shaped. In five of the seven caches containing figurines were containers in the form of a barrel-shaped cylindrical urn. One of the offerings is a mask which is undoubtedly the finest jade object yet found in British Honduras. It is now in the British Museum. A mirror of iron pyrites was found at Hatzcap Ceel, but the remains of what was probably a second were too far corroded to permit of certain identification.

The evidence of the pottery showed that these two sites belong to the same general cultural area as Holmul, Yalloch, and Uaxactun—an area in which art, as exemplified in stone carving on altar and stela, did not fall far short of that of the larger cities of the Peten region in what is now Guatemala, but architecture and the ability to erect large carved stone monuments did not penetrate here until late in the Old Empire period. It would appear that the art of erecting large multiple vaulted buildings never reached the Mountain Cow Water Hole region.

The two residential sites, Tzimin Kax and Cahal Cumil, consist of a number of scattered plazas of small size, constructed on the tops of natural hillocks enlarged by piling around them masses of stone and rubble up to a height of three or four feet above the

natural summit. The whole was then levelled up, and pyramidal square and low oblong mounds erected at the edge of the platform thus constructed. The platforms average twenty-five metres in each direction and are orientated within three or four degrees of true north. The outside walls were made of blocks of stone roughly faced but unsquared. The fill is of large limestone boulders and a small amount of rubble, but is loose. There is evidence that the platforms were reconstructed on several occasions.

A number of burials was associated with most of the plazuelas. This would be fully in accord with what we know of Maya practice. Bishop Landa says that it was customary for the people of Yucatan to bury their dead under the house, and among the modern Maya, children are buried under the floors of the huts. It is to be noted that in a burial at Tzimin Kax a number of small crude pots were found in pairs, one being placed mouth downwards over the other. Three of these contained bones: in one the first, second, and third dactyls of a human hand, judging by its size, of a woman or adolescent, and in a second a single bone, which proved to be the second dactyl of a small adult's hand. Dr. Gann also records the finding of the terminal phalanx of "a Maya lady's little finger" from a burial near Progreso. The skeletal remains were in a bad state of preservation, but Prof. Elliot Smith reported on two skulls as showing marked antero-posterior deformation.

The two residential sites were evidently occupied for a longer period than the ceremonial centres. Reference to the classification made by Dr. Vaillant at Holmul shows that all four sites were occupied in the period Holmul V, while the earlier period of Holmul I is represented in burials at both the residential sites. At Cahal Cumil there is certain evidence which points to a still earlier period of 'pre-Holmul'. Pottery of the same type has been found at Uaxactun in conditions which point to its being earlier than Holmul I. It must be remembered that although this correspondence with Holmul is established in the Mountain Cow Water Hole area, it does not necessarily follow that in absolute dating the two are contemporary, the latter being a peripheral area. Holmul pottery may have reached it at a later date. It is clear that the sites were not occupied after the introduction of metal.

### Forecasts of Fisheries

A REPORT of the activities of the various area committees of the International Council for the Exploration of the Sea has recently been published.\* In small compass, it may be said to place before the public of the different nations represented in the Council the aims and present achievements of marine investigation. Amongst a wealth of valuable and interesting material, the report of the Northern North Sea Committee deserves special mention, as recording a notable landmark in the history of fishery research.

In the work of this Committee, most attention is being given to the herring and the haddock—the two most important commercial fishes of the northern North Sea. As a result of this concentration of effort, there is being built up, slowly but surely, a very definite knowledge of the composition of the stocks of these two species which is of immediate value for an understanding of the fluctuations in the practical fisheries. Much still remains to be accomplished,

more particularly with regard to the correlation of these fluctuations in the year classes of fish entering the marketable stocks with the successive changes in hydrographical and biological conditions in the sea.

Nevertheless, the work on the haddock has reached a stage when the yield of the North Sea haddock fisheries for eighteen months or two years ahead can be anticipated with great accuracy. Definite forecasts, made only experimentally as yet, have proved most satisfactory. For example, the general success of a forecast made in April 1929 at the scientific meeting of the International Fisheries Conference in London is cited. At that meeting it was stated that the fairly successful 1926 brood should, for most of its fourth year (1929), serve to provide catches just above normal. By the end of the autumn of that year, however, this brood should have made the greater part of its contribution to the catches. The 1927 brood had proved a failure, so catches would therefore be expected to sink below normal from late autumn 1929 to well on in 1930. But about August of the latter year there should take place a marked increase in the catches owing to the upgrowth of the highly successful 1928

\* Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 74. Procès-verbaux (Mars 1931). Pp. 203. (Copenhague: Andr. Fred. Høst et fils, 1931.) 7 75 kr.

brood In 1931 still greater catches should accrue The course of events in the commercial fishery agreed very closely with the above prediction

In the report now before us forecasts are made for an ensuing period as far forward as the middle of 1933 After the autumn of 1931, when most of the 1928 brood has been fished out, a sharp drop in the catches is predicted, owing to paucity of the 1929 and 1930 broods Landings will continue below normal throughout 1932 and during at least the first half of 1933 The result of the 1931 spawning is not known at present, but a good brood is hoped for in order to relieve the depression which always follows when two successive years produce numerically unsatisfactory broods

G A S

### Mobilities of Atmospheric Large Ions

A RECENT paper by R K Boylan entitled "The Mobilities of Atmospheric Large Ions"\* is of obvious importance in the subject of atmospheric electricity, which has engaged the attention of many meteorologists since Elster and Geitel's pioneer researches many years ago Of the two classes of ion present in atmospheric air, the large ions of small mobility discovered by Langevin are normally the most numerous, and there is general agreement in fixing their mobility at 0 00033 cm/sec/volt/cm These appear to be the principal nuclei of condensation for water vapour, and to be the result of small ions attaching themselves to uncharged particles of dust

It is pointed out by Boylan that whereas McClelland and P J Nolan have found ions of smaller mobility in air treated in various artificial ways, such as bubbling through alcohol or passage over flames, it is generally believed that ions larger than the Langevin ions, that is, ions of smaller mobility, are absent from untreated air Experiments conducted by Boylan on air in a well-ventilated room in Dublin gave strong reason for disbelieving this conclusion Experiments were made on the usual lines, air being drawn at measured speeds between two lengths of concentric brass tubing, between which high tension electric fields of various known strengths were maintained, the current being measured by an electrometer Since ions tend to group themselves around certain mobilities, these groups can be detected by looking for discontinuities in the curve obtained by plotting current against voltage, at such points all the ions of a given mobility are just collected on the inner electrode during the passage of the air through the tube Boylan used both the McClelland and Zeleny methods of working with this apparatus, and tried many variations of air speed

Curves derived by both methods agreed in showing clear evidence of the presence of several groups of large ions of mobilities higher and lower than that of the Langevin ions So far from indicating 'saturation', that is, complete removal of ions, at a voltage corresponding with the mobility of the Langevin ion, the ionisation measured increased by amounts varying from 28 to 200 per cent when sufficient voltage to produce saturation was applied

The difficulties of accurate measurement of the mobility of each group were very great, for the use of very high voltage or very slow speed, or some compromise between the two, is essential when dealing with such low mobilities, and each gives rise to its particular source of error or uncertainty For this reason, Boylan does not claim to give a complete or accurate catalogue of the larger ions Among the principal groups more mobile than the Langevin ions

may be mentioned those of mobility 0 0008 and 0 0006, and among the less mobile groups those of mobility 0 0009 and 0 00006 There was striking general agreement with many of the artificially produced groups observed by J J Nolan and by McClelland and P J Nolan It is considered that very few of these ions would be found in the air of country districts

E V N

### University and Educational Intelligence

APPLICATIONS for Ramsay Memorial fellowships for chemical research, one of which will be limited to candidates educated in Glasgow, will be considered by the trustees at the end of June Particulars of the fellowships can be obtained from the Secretary, Ramsay Memorial Fellowship Trust, University College, Gower Street, WC1 The application forms must be received by, at latest, May 31

THE Carnegie Trust for the Universities of Scotland has recently had under consideration the question whether, in view of the public assistance now available to the Scottish university student, the payment of class fees from funds dedicated under the Trust deed to this object should be continued In its thirtieth annual report, the Trust's executive committee declares that the system whereby education authorities assist necessitous and deserving students has not yet reached in practice such a stage of development and uniformity as would warrant the immediate withdrawal from those eligible of the payment in part of class fees by the Trust, and that the special circumstances of the times are such as to render any such new departure inexpedient for the present The amount spent by the Trust in this way in 1930-31 was £56,366 During the past four years, inquiry into the financial circumstances of each applicant's household has been made before admission to the benefits of the Trust, and it has been determined that in the case of all entrants to the university under twenty-one years of age the minimum standard of requirement for admission to these benefits shall be the obtaining of higher grade passes in three subjects in the Leaving Certificate Examination or in recognised equivalents During the year, former beneficiaries have repaid a sum of £1891 voluntarily The Trustees' scheme for the endowment of research is reported to be functioning very successfully The awards, however, are limited to £16,000 a year, which is only half of the aggregate of the grants applied for

"RADIO and Education" is the title of a short historical survey issued by the Office of Education, Washington, of the educational uses of wireless transmission in America The work of amateurs is one phase of education by radio which the United States Army and Navy have in the past done much to foster At the present time, there is a vast amount of direct instruction by broadcast lectures, one of the most important examples of which is the National Broadcasting Company's music appreciation hour directed by Walter Damrosch in connexion with the concerts of the New York Symphony Orchestra and listened to by some millions of pupils at every lecture The 'American School of the Air' gives a half-hour period of instruction daily in historical drama, Nature study, vocational guidance, and a wide range of other topics which fit into the curricula of the public schools Of the enterprises of State departments in this field, the Ohio School of the Air is the most extensive and thorough Its programmes, comprising geography, rhythmic exercise, French, and other high-school subjects, are broadcast one hour each day and are

\* *Proc Royal Irish Academy*, vol 40, Section A, No 4



listened to in twenty-nine States. There is a clash of interests between commercial and public institutional broadcasting, the demand for radio channels for commercial use having been so great that the right of the State to use this medium even for police purposes has been challenged. Practically all the commercial broadcasting stations devote much (in the aggregate about a tenth) of their time to 'educational' programmes. There are indications, however, that the advertising programmes are gradually displacing the educational, except at educational stations.

### Calendar of Geographical Exploration

#### April 19, 1827 — The Niger and Timbuktu

M Caillié, a French government official of Sierra Leone, left Kakund, on the Nunez river, midway between Sierra Leone and the Gambia. With a small caravan of Mandingoes he crossed the region through which ran the upper tributaries of the Senegal and the Niger. He was the first European to enter the town of Jenné, on the Niger, though Park had seen it on his last journey. From Jenné he sailed down the Niger to Kabara, the port of Timbuktu, and reached that city on horseback. Caillié found the city to be a collection of mud huts, among which rose several rudely built mosques. To north-east and south of it spread vast deserts, and after a fortnight's stay, Caillié and his caravan began a march across the Sahara to Morocco. In one tract the travellers marched ten days without a drop of water, men and animals suffered severely, but ultimately Caillié won his way through Tafilet and the Atlas to Fez and Tangier. Timbuktu was first reached by a European in 1826, when Major Lang paid for his pioneer entry into the mysterious city with his life.

#### April 20, 1534 — Cartier and the St. Lawrence

Jaques Cartier sailed from St. Malo, in charge of an expedition to look for a north-west passage to the Orient. He reached Newfoundland on May 10, but was delayed by ice. Then began his series of explorations of the coasts of Newfoundland, Labrador, and the islands and straits off the coasts of Canada. In 1536, on a second voyage, he sailed up the St. Lawrence estuary and reached the site of the present Montreal, of the scenery around which and of the Lachine Rapids he left a vivid description. Cartier's work in charting these coasts and discovering the region of the St. Lawrence, which was later settled by the French, was of outstanding importance.

#### April 22, 1500 — The Coast of Brazil

Pedro Alvares Cabral sighted the coast of Brazil. He had been sent out by the Portuguese Government to follow up da Gama's discovery of an 'all sea' route to India, and da Gama had himself drawn up the sailing directions. In order to avoid the calms off the Gulf of Guinea, Cabral bore so far to the west that the coast of South America was discovered. Early in the same year the Spanish navigator, Vicente Yanez Pinson, had touched the coast of Brazil, but Cabral did not know of this.

#### April 22, 1898 — Cambridge Expedition to the Torres Straits

Dr A. C. Haddon arrived at Thursday Island in charge of an expedition closely associated with the University of Cambridge. The expedition was of a unique character, for it was the first occasion on which investigations into the psychology of primitive peoples were carried out on a thoroughly scientific

basis. Dr Haddon gathered round him for this pioneer effort a brilliant group whose names are now world-famous in psychology, including the late Dr W. H. R. Rivers, Dr C. S. Myers, Prof W. McDougall, and Prof C. G. Seligman. The scientific data gathered have been published in several volumes, which have become standard sources of inspiration for all subsequent field workers in primitive psychology and in the social and physical anthropology of native peoples. The members of the expedition visited many islands in the Torres Straits, and also studied tribes in the Central and Mekeo districts of British New Guinea and in the Baram district of Sarawak. In 1888-89, Dr Haddon paid a visit to the Torres Straits, and became deeply interested in the life of the natives, the confidence which he then inspired in them paved the way for the friendly relations essential for the success of scientific work among these 'head-hunting' tribes.

#### April 22, 1908 — Stefansson in the Arctic

Vilhjalmur Stefansson set out on an expedition, during which he discovered several Eskimo tribes and obtained much information about their way of life. Stefansson began his career of exploration by archaeological research in Iceland in 1904. In 1905 he turned to arctic research, and by 1928 had spent ten winters and thirteen summers in scientific work north of the Polar Circle, always living like the Eskimo and therefore travelling light. The Canadian arctic expedition under Stefansson in 1913-18 is estimated "to have withdrawn nearly 100,000 square miles from the areas of unknown seas and lands". On this expedition the ship *Karluk*, carrying part of the group, was crushed in the ice and sank. Its crew reached Wrangel Island, where a relief ship rescued the survivors—Capt Bartlett, commander of the *Karluk*, having bravely walked to Siberia to bring help.

#### April 23, 1556 — The English on the Arctic Coast of Russia

The *Searchthrift*, commanded by Stephen Burrough, left Ratcliffe on a voyage to search for the north-east passage. Sebastian Cabot, then a very old man, came on board to wish them God-speed. Burrough met many Russian and Finnish *lodjas* (sailing boats with boards bound fast together by willows, not riveted). These fishing boats gave him much help, and were able to sail more easily and rapidly than the *Searchthrift*. Burrough, after reaching Vaygatz, returned to Kholmogory and wintered there, intending to proceed to the mouth of the Ob River next season. Instead of doing this, he turned westwards to search for Willoughby and the two vessels lost with him in the 1553 expedition. His voyage set up a new record of arctic penetration and made it clear how great were the difficulties of voyages in these very high latitudes. He brought back interesting accounts of the life and customs of the Samoyedes.

### Societies and Academies

#### LONDON

Geological Society, Feb. 24 — G. C. A. Jackson. The geology of the N'Changa district, Northern Rhodesia. The area, which forms part of the original Rhodesian Congo Border Concession, covers approximately 800 square miles, and lies immediately to the south of the Belgian Congo border. It is a wooded peneplain, underlain by four principal series of ancient metamorphosed and unfossiliferous sediments, namely, basement schists, Muva series,

Bwana M'Kubwa series, and Kundelungu series. The complex ranges from the Archaean to possibly the Lower Palaeozoic in age. Petrological descriptions were given of all the principal rock types—G. V. Douglas. General geology of a portion of Northern Rhodesia. The climatic cycle since Tertiary times, which was first desert, changed to rain-forest conditions, and is now reverting to aridity. The evidence adduced was the deep oxidation in the mines and the presence of huge dead anthills. In the eastern part of the area, pegmatite dykes with coarse and fine crystallisation occur. The coarse texture is found on the *hanging wall*, where the dykes are inclined. Where the dykes are vertical, the coarse crystallisation is found in the centre. These dykes furnish ancient plumb lines, if the dykes are now found with the coarse crystallisation on the hanging wall, it can be inferred that the country has not been flexed since the time when these dykes were consolidated. In Northern Rhodesia this phenomenon is a means of distinguishing between the older and younger granites. The trend lines of the area run from north-east and south-west in the eastern part to north-west and south-east in the section from N'Dola to some point to the west of N'Changa, in the western part the general trend is north-east and south-west, swinging into Angola.

## PARIS

Academy of Sciences, March 7—Marcel Brillouin. The critical latitudes. A contribution to the dynamical theory of tides—Charles Nicolle and Jean Lagret. The presence of a bacterium analogous with *Rickettsia* in the vaginal tunic of guinea-pigs and rats, inoculated by way of the peritoneum with non-virulent products. These bacteria appear to exist in the organism of the rat and guinea-pig, either normally or, more probably, habituated—C. Camichel, L. Escande, and G. Sabathé. The similitude of barrages with lateral contractions—Jean Baptiste Senderens. The comparative value of various catalysts in the formation of esters. Comparison of the catalytic effects of sulphuric acid, sodium bisulphate, potassium bisulphate, aluminium sulphate, and phosphoric acid in the formation of alkyl acetates—Henri Lagatu and Louis Maume. The application of the leaf diagnosis—Henri Villat was elected a member of the Section of Mechanics in succession to the late G. Koenigs—Gaston Julia. A canonical conformal representation of multiply connex areas—A. Buhl. An invariance of double integrals attached to any ordinary differential equation of the first order—Mandelbrojt. Theorems on the convergence of Taylor's series with gaps—T. Vijayaraghavan. The growth of functions defined by differential equations—S. Sanelevici. Singular integral equations—Arnaud Denjoy. The characteristics of the surface of the anchor ring—Julius Wolff. The iteration of holomorph functions in a demi-plane—N. Abramesco. The circle of univalence of a holomorph function  $f(x)$  and the smallest distance between two zeros of an equation  $f(x)=A$ —Al. Proca. The magnitudes characteristic of the Dirac electron—J. Haag. The experimental determination of the damping couple of an oscillator—R. Serville. The passage from the viscous to the hydraulic régime for the movement of a solid in water—Robert Gibrat. The mathematical adjustment of the delivery curves of a water-course—F. Bourquard. Oblique plane ballistic waves and conical waves. Application to the study of air resistance—Dubourdieu. The electromagnetic field produced by a wire carrying a sinusoidal alternating current above a conducting layer—A. Portevin and P. Bastien. Casting alloys. Relation with the interval of solidification—A. Turpain and H. Sabatier.

Contribution to the experimental study of electrical induction—J. Rabinovitch. The rotatory dispersions of benzene solutions of  $\alpha$ -dextrorotatory pinene and  $\beta$ -lavorotatory pinene—A. Kastler. The Raman effect and the dipolar moment—R. de Malleman, L. Gabiano, and F. Suhner. The magnetic rotatory power of neon. The Verdet constant for neon is one-sixth that of hydrogen and one-eighth that of argon. In the case of the monatomic gases, there is a simple connexion between the magnetic rotation and the corresponding refraction. This is not the case with the polyatomic gases—Constantin Salceanu. The variation of the temperature constant of magnetic double refraction and of the Havelock constant for some fused organic substances—André Marcelin and Lew Kowarski. The measurement of the thickness of thin crystalline plates by variation of incidence—R. Forrer. The thermal law of homopolar linkages. Law of the Curie points and the melting point law—P. Jacquet. An electrochemical method permitting the evolution of solutions of gelatine to be followed as a function of the time—Pierre Jolibois and Georges Foutetier. The photographic registration or reactions between electrolytes. The method is applicable to reactions which modify the electrical conductivity of the liquid medium in which the reactions take place—Sze Shih-Yuan. The magnetic spectrum of the  $\beta$ -rays emitted by thorium-B—Mme Irène Curie and F. Joliot. The projections of atoms by the very penetrating rays excited in light nuclei—Pierre Auger. The projection of light nuclei by ultra-penetrating radiations of excited radioactivity. Trajectories photographed by the Wilson method—Charles Dufrasse and Daib Nakaé. The catalysis of autoxidation. The antioxygen properties of cobalt. Observations concerning current theoretical discussions. Results of a detailed study of the action of metallic cobalt, its oxides, and salts on the oxidation of furfural. There appears to be no element which acts exclusively as an accelerator of oxidation—T. Nanty and M. Valet. The specific inductive capacity of colloidal solutions. Aqueous solutions of various dyestuffs were examined. While some (Congo red, diamine blue, diamine black) show a marked increase in the specific inductive capacity, others gave the same figure as pure water—G. Gire. The reduction of magnesia by silicon. A mixture of silicon and magnesia in the proportion Si 2MgO, heated in a vacuum for three hours between 1280° C and 1320° C, gave a sublimate of metallic magnesium on the cold part of the tube. About sixty per cent of the magnesia was reduced to metal—L. Bert and E. Ander. A new type of true acetylene compound, phenoxypropyne. The reaction between the compound  $C_6H_5 \cdot O \cdot CH_2 \cdot CH=CHCl$  and metallic sodium in boiling toluene gives rise to phenoxypropyne,  $C_6H_5 \cdot O \cdot CH_2 \cdot C \cdot CH$ . This is shown to be a true acetylene derivative and the first term of a new series—Rene Wurmser and Mlle Nelicia Mayer. The reversibility of the oxidoreducing system of solutions of glucides—Marius Badoche. Hydrocarbons isomeric with rubrene obtained by the hydrogenation of 9, 11-diphenyl-9, 12, 10, 11-diphenylene-9, 11-dihydronaphthacene—M. Grunfeld. The chemical reactivity of certain classes of amines. Measurements of the reaction velocities between ethyl malonate and six amines—Georges Denigès. Formaldoxim, a very sensitive reagent for metals of the iron group, especially manganese. Various applications—Jean Lacoste. The Senhadjas massif (Southern Rif)—L. Cagniard. The propagation of a shock at the interior of a homogeneous, isotropic, elastic, semi-indefinite solid, limited by a plane surface—Henry Hubert. The air currents superposed in the dry

season above the Cape Vert peninsula—Henri Gauthier The cells with rods in fishes—Raymond-hamet The effects of adrenalin on the vessels of the paw and of the kidney—A Girard, G Sandulesco, A Fridenson, and Ir J J Rutgers A new crystalline sexual hormone extracted from the urine of pregnant mares—Émile André and Raoul Lecoq The reserves of vitamin A and D in some cartilaginous fishes.—G Tanret The glucosides of the leaves of the oleander *Nerioloside* extracted from the *Nerium oleander* is distinct from the glucosides of *Strophanthus*—E Marchoux and V. Chorine The culture of the invisible forms of the spirochete of fowls—P. Durand The dog as a reservoir of the virus of fièvre bouton-neuse.

## ROME

Royal National Academy of the Lincei, Nov. 15—Gr C Moisil Generalisation of conjugate functions—M Kourensky Integration of equations to partial derivatives of the second order with one unknown and two independent variables—M Ghermanesco. *n*-Metaharmonic functions—S Finikoff The transformation *T* of congruences of straight lines—P Barreca A method for reducing to the equator and to the equinox the separate durations of evening and morning colorations of clouds—G Devoto Investigations on the dielectric constants of liquids (6) Aqueous solutions of sulphamide The experimental data obtained indicate for sulphamide a polar formula,

probably,  $\text{NH SO} \begin{smallmatrix} \text{NH}_3^+ \\ \text{O}^- \end{smallmatrix}$ , which is analogous to that proposed for carbamide in aqueous solution, namely,

$\text{NH C} \begin{smallmatrix} \text{NH}_3^+ \\ \text{O}^- \end{smallmatrix}$ —A Ferrari and C Colla Chemical

and crystallographic investigations on complex nitrites (1) The crystallographic analogy of potassium cobaltinitrite to the potassium-lead-nickel, potassium-lead-cobalt, and potassium-lead-copper triple nitrites has recently been demonstrated, the results obtained indicating that the water often found on analysing the cobaltinitrite is not combined directly with the molecule but is water of impregnation Results of measurements on a further series of complex nitrites, isomorphous with the others, are now given  $\text{K}_2\text{Ca}[\text{Ni}(\text{NO}_2)_6]$ ,  $a = 10.29 \text{ \AA}$ , calculated density 2.75,  $\text{K}_2\text{Sr}[\text{Ni}(\text{NO}_2)_6]$ , 10.49, 2.88,  $\text{K}_2\text{Ba}[\text{Ni}(\text{NO}_2)_6]$ , 10.67, 3.02,  $\text{K}_2\text{Ca}[\text{Co}(\text{NO}_2)_6]$ , 10.17, 2.86,  $\text{K}_2\text{Sr}[\text{Co}(\text{NO}_2)_6]$ , 10.23, 3.10,  $\text{K}_2\text{Ba}[\text{Co}(\text{NO}_2)_6]$ , 10.45, 3.20 Similar compounds with copper in place of cobalt or nickel give photograms with what appear to be the lines of two isomorphous monometric lattices—G Mezzadrol (1) Action of ultra-short electromagnetic waves on silkworms irradiated prior to incubation This action produces a favourable effect throughout the whole life-cycle of the worms—hatching, growth, and spinning—and results in an increased final product—(2) Action of Italian radioactive soils on the germination of seeds and on the growth of plants The influence of finely ground Italian soil of radioactivity  $4.2 \times 10^{-9}$  per gram on plants (peas, maize) grown in the laboratory in Knopp's nutrient solution is manifested in marked increase in the length of the roots and in the development of the plants Field experiments in which the radioactive soil was used as fertiliser result in stronger and greener plants and in yields exceeding by 20 per cent or more those of the controls—A Galamini The fasting and re-nutrition curves in castrated male rats

## VIENNA

Academy of Sciences, Dec 10—L Schmid and E Kotter (1) A trityl-ether of glycogen (2) The dye of the mullein blossoms, *Verbascum* The pig-

ment is a glucoside, apparently  $\alpha$ -crocetin—A Jellinek Training experiments with long-tailed monkeys, *Cercopithecus* (1) Distinguishing objects by colour, brightness and tone Coloured cardboard boxes were used and a reward of sugar They learnt to distinguish yellow from violet—(2) The monkeys learnt to distinguish a framework box containing one lump of sugar from a similar box containing two lumps of sugar, being rewarded with the sugar when they chose the one lump—E Murr (1) Experimental reduction, by heat, of the time of gestation in the ferret (*Putorius furo*) Some ferrets were kept at 20° and some at 35° Those at the lower temperature had a gestation period of about 41½ days, those at the higher temperature about 39½ days—(2) The course of bodily temperature in mammals (*Putorius furo*) during gestation In the first part of gestation the temperature is slightly higher than in the second half—H Przibram and P Suster Antenna and leg regeneration in phasmids—P M Suster Regeneration of antenna and of Johnston's organ in the rhinoceros beetle, *Oryctes nasicornis*—P M Suster Inheritance of enforced feeding on *Drosophila repleta*. Ten generations of the fly were fed on carrot, and afterwards, for five more generations, carrot was offered as an alternative and much more frequently chosen for egg-deposition—K. Trinczer The rôle of temperature and humidity in the colour-change of frogs—K Fritsch Observations on flower-visiting insects in Styria, 1911

## WASHINGTON, D C

National Academy of Sciences (*Proc*, vol 17, No 12, Dec 15)—Carl E Seashore The natural history of the vibrato A study of the vibrato has been made by (1) phonophotographic recording of music and speech, and (2) psychophysical measurements of perception of vibrato produced synthetically by instruments A definition of vibrato is offered an artistic vibrato consists of a periodic oscillation in pitch averaging a half-tone for singers and a quarter-tone for string instruments, at an average rate of 6-7 cycles a second, usually accompanied by synchronous intensity and timbre oscillations playing a secondary rôle—Walter R Miles Measures of certain human abilities throughout the life span Manual motility and reaction speed in males show a general increase up to the 'twenties', and then a gradual decline with age It is suggested that neural conservation mechanisms become more potent with increasing age—George Grant MacCurdy The use of rock crystal by palaeolithic man Seven rock crystal tools have been found by the American School of Prehistoric Research in the lower of two Mousterian levels in a rock shelter, Les Merveilles, at Castel-Merle, near Sergeac (Dordogne)—Wilder D Bancroft, Robert S Gutsell, and J E Rutzler, jr Reversible coagulation in living tissue (9)—Morphine addiction was induced in dogs and the symptoms on sudden withdrawal of morphine (which agglomerates nerve colloids) were relieved by sodium rhodanate (which peptises the nerve colloids)—W V D Hodge Further properties of Abelian integrals attached to algebraic varieties—George D Birkhoff (1) Proof of a recurrence theorem for strongly transitive systems—(2) Proof of the ergodic theorem—O Veblen and J H C. Whitehead Correction to "A set of axioms for differential geometry"—H S Vandiver Summary of results and proofs on Fermat's last theorem (6)—P A Smith Properties of group manifolds—A Wintner and F D. Murnaghan On a polar representation of non-singular square matrices—Joseph M Dalla Valle Note on the Heaviside expansion formula—Edwin B Wilson and Margaret M Hilferty The distribution of chi-square ( $\chi^2$ )—H Bateman Relations

between confluent hypergeometric functions—G A Miller Groups involving a small number of conjugates—Marcus M Rhoades Linkage values in an interchange complex in *Zea* Evidence is given of the occurrence of reciprocal translocation (segmental interchange) in a semi-sterile maize—P C Mangelsdorf Modification of Mendelian ratios in maize by mechanical separation of gametes Separating the pollen grains by sieves into tiny and normal showed that the genes for 'starchy' and 'sugary' are genetically associated with size of pollen grain, the tiny grains accomplish fertilisation only rarely in competition with normal grains—Clyde E Keeler A probable new mutation to 'white-belly' in the house mouse, *Mus musculus*

### Forthcoming Events

#### FRIDAY, APRIL 15

SOCIETY FOR EXPERIMENTAL BIOLOGY (in Department of Zoology, University Museums, Oxford), at 10 30 A.M., 2 30, and 5 30

ROYAL ANTHROPOLOGICAL INSTITUTE (Sociological Research Committee), at 2.—J H Driberg Economic Stages of Development in Africa

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at 36 George Street, Manchester), at 7 —Annual Meeting

#### SATURDAY, APRIL 16

SOCIETY FOR EXPERIMENTAL BIOLOGY (in Department of Zoology, University Museums, Oxford), at 10 A.M. and 2 30

#### MONDAY, APRIL 18

ROYAL GEOGRAPHICAL SOCIETY, at 5.—S T A Mirrlees The Weather on a Greenland Air Route Discussion of Meteorological Results of the B A R E

ROYAL SOCIETY OF ARTS, at 8.—Prof J C Drummond Recent Researches in the Nature and Functions of Vitamins (Cantor Lectures) (1)

#### TUESDAY, APRIL 19

ROYAL SOCIETY OF MEDICINE—Special Meeting of Fellows, at 5, General Meeting of Fellows, at 5 30

GRESHAM COLLEGE (Basinghall Street, E C 2), at 6.—A R Hinks Celestial Objects of Peculiar Interest (Gresham Lectures) (Also on April 20, 21, and 22)

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6 30 —Annual Meeting

#### WEDNESDAY, APRIL 20

SOCIETY OF GLASS TECHNOLOGY (at Sheffield University) —Annual General Meeting, at 2, Ordinary Meeting, at 2 30.—R A Hacking Recent Developments in Open Hearth Furnace Design—Dr G Zotos A New Method of Melting Glasses and Silicates

TEXTILE INSTITUTE (at Manchester), at 3 —Annual General Meeting

ROYAL SOCIETY OF ARTS (Dominions and Colonies Meeting), at 4 30.—J O P Bland China and the Future of our Far Eastern Trade (Lecture)—At 8.—J G Jarvis Instalment Buying (Lecture)

ROYAL MICROSCOPICAL SOCIETY (at B.M.A. House, Tavistock Square), at 5.—Discussion on The Microscopy of the Filterable Viruses Speakers The President, J E Barnard, Prof J C G Ledingham, Dr S P Bedson, Dr C C Hurst, Prof J McIntosh, Capt S R Douglas, Dr W J Elford, Dr G M Findlay, B K Johnson, and others

#### THURSDAY, APRIL 21

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr W E Sumpner The Work of Oliver Heaviside (Kelvin Lecture)

#### FRIDAY, APRIL 22

ROYAL ANTHROPOLOGICAL INSTITUTE (Human Biology Research Committee), at 5 30.—Prof J B S Haldane Present Knowledge concerning Blood Groups

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (Annual General Meeting) (at Waldorf Hotel, Aldwych), at 6 45, followed by dinner at 7 30—Sir Robert Horne Currency and Prices (Address)

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof J B S Haldane Hereditary Transmission of Acquired Characters

#### SATURDAY, APRIL 23

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin)—Prof J K Catterson-Smith Everyday Uses of Electricity (Faraday Lecture)

### Official Publications Received

#### BRITISH

Transactions of the Institute of Marine Engineers, Incorporated Session 1932, Vol 44, No 2, March Pp 57 106+xxxvi (London)

The Quarterly Journal of the Geological, Mining and Metallurgical Society of India Vol 3, No 3, November 1931 Pp 83 151 (Calcutta) 6 rupees

Annals of the Royal Botanic Gardens, Peradeniya Edited by N D Simpson (Ceylon Journal of Science, Section A Botany) Vol 11, Part 4, February 20th Pp 207 359+plates 45 62 (Peradeniya Director of Agriculture, London Dulau and Co., Ltd) 3 rupees

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 56 A Soil Survey of Blocks A, B, C, D and F, Renmark Irrigation District, South Australia By T J Marshall and P D Hooper Pp 23 Bulletin No 58 The Life Cycle of *Stephanurus dentatus* Deising, 1839, the Kidney Worm of Pigs, with Observations on its Economic Importance in Australia and Suggestions for its Control By I Clunes Ross and G Kanwal Pp 80 (Melbourne H J Green)

Proceedings of the Edinburgh Mathematical Society Series 2, Vol 3, Part 1, March Edited by Prof H W Turnbull and Dr E T Copson Pp 76 (London G Bell and Sons, Ltd)

British Honduras Annual Report of the Forest Trust for the Year ended 31st March 1931 (Belize Conservator of Forests)

Proceedings of the Royal Society of Edinburgh, Session 1931-1932. Vol 52, Part 2, No 6 On the Definition of Spatial Distance in General Relativity By H S Ruse Pp 183-194 1s Vol 52, Part 2, No 7. Graphical Classification of Carbonaceous Minerals, the Place of the Constituents of Common Coal By Prof Henry Briggs Pp 195 199 8d (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd)

Research Association of British Rubber Manufacturers Twelfth Annual Report for the Year 1931 Pp 36 (Croydon)

Journal of the Chemical Society March Pp iv+725 988+vi (London Chemical Society)

#### FOREIGN

Bulletin of the Bingham Oceanographic Collection, Peabody Museum of Natural History, Yale University Vol 4, Art 2 A Revision of the Genus *Gobionellus* (Family Gobionidae) By Isaac Ginsburg Pp 51 (New Haven, Conn)

Science Reports of the Tokyo Bunrika Daigaku Section A, Nos 15 17 Burkhansen Kurz Effekt nach der Wellenmechanik, von Kwa Umeda, Wave-Length Shifts of certain Spectral Lines of Hg II, by Atô Imazoto, A Theory of the Rotatory Dispersion, by Gentaro Araki Pp 167-201 (Tokyo Maruzen Co., Ltd) 47 sen

Meddelande från Lunds Astronomiska Observatorium Ser 1, Nr 129 The Effect of Change of Origin in Type A Series By Richard A. Robb Pp 12 Ser 1, Nr 130 The Application of Type A Series to Skew Curves By Richard A. Robb Pp 10 (Lund)

Field Museum of Natural History Report Series, Vol 9, No 1 Annual Report of the Director to the Board of Trustees for the Year 1931 (Publication 806) Pp 257+22 plates (Chicago) 1 dollar

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 84 Reptiles and Amphibians from Honduras By E R Dunn and John T Emlen, Jr Pp 21 32 (Philadelphia)

Contributions to American Archaeology, Vol 1, Nos 1 4 Excavations at Baking Pot, British Honduras, by Oliver Ricketson, Jr, Maya Astronomy, by Dr John E Teeple, The Temple of the Wall Panels, Chichen Itza, by Karl Ruppert, Notes on the Metates of Chichen Itza, Yucatan, by Gustav Strömmsvik (Publication No 403) Pp iii+157+49 plates (Washington, D.C. Carnegie Institution)

Contributions to the Genetics of certain Chromosome Anomalies in *Drosophila melanogaster* By A H Sturtevant and T Dobzhansky (Publication No 421) Pp v+81 (Washington, D.C. Carnegie Institution)

Meddelelser fra Kommissionen for Danmarks Fiskeri og Havundersøgelser, Serie Fiskeri Bind 9, Nr 1 Biological Investigations upon the Cod in Danish Waters By Erik M Poulsen Pp 150 160 10 kr Bind 9, Nr 2 Investigations of the Place Stock in the Southern Homs Reef Area in the Years 1928-1930 By Aage J C Jensen Pp 32 2 50 kr Bind 9, Nr 3 Fluctuations in the Stock of Cod in Icelandic Waters By A Vedel Tønning Pp 43 8 15 kr Bind 9, Nr 4 On the Spawning Places of the Herring in certain parts of the North Sea, the Skagerrak and the Kattegat in the Autumn of 1930 and some Earlier Years By Erik M Poulsen Pp 17 (København C A Reitzels Forlag)

#### CATALOGUES

Botany, Entomology, Ornithology, Zoology, etc Catalogue of Books at Cheap Clearance Prices (No 198) Pp 16 (London Dulau and Co., Ltd)

A Catalogue of Important and Rare Books on Zoology, Geology and Palaeontology (No 456) Pp 100 (London Bernard Quaritch, Ltd)

Old Time Literature, principally of XVIIIth and XVIIth Centuries (No 461) Pp 80 (Cambridge Bowes and Bowes)

Temperature Measurement Pp 4 (London Negretti and Zambra)



SATURDAY, APRIL 23, 1932

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## Scientific Research and Patent Law

ONE of the most striking features in the advance of present-day science is the importance which borderland sciences have come to assume. In part this has resulted from the growing tendency towards intensive specialisation, and as more and more fields are demarcated the debatable lands tend to be neglected. With the advance of science there has been a parallel growth in its diversity. Chemists and other classes of scientific worker are tending more and more to subdivide themselves into special sections which often have little in common, and the 'general practitioner', whether in medicine or elsewhere, has tended to lose caste.

Specialisation has its own grave dangers of sterility of thought and a one-sided way of regarding the problems of science or of life, and it is accordingly significant that some of the most important recent advances in science have come in the borderline fields which demand the co-operation of specialists in several branches of science. Notably this is true of advances in chemotherapy and discoveries in the vitamin field, while industrial research could provide numerous examples. The contact thus engendered between different branches of science provides the necessary safeguard against sterility of thought, and this was probably what prompted Major F A Freeth's recent suggestion that the time has come when research should be organised by divisions of science and not by divisions of practice, and that, for example, an institution devoted to the study of high temperature equilibria, in which all the necessary classes of scientific workers were engaged, would produce more valuable scientific and industrial results than the study of special problems from the scientific or industrial side.

Contact between different branches of science can, however, only be full and fertile if there are no artificial barriers of thought or practice, and from this point of view it seems at least open to question whether the proposal to differentiate between medical and other classes of patents is wise. The Medical Research Council in its recent report reverts to the question of British patent law in relation to medical research, and publishes as an appendix to the report a memorandum setting forth the views which were submitted in 1929 to the Departmental Committee appointed by the President of the Board of Trade. The proposal for special treatment of medical patents was further elaborated into a draft scheme for 'dedicated patents' in a memorandum

on British Patent Law Reform prepared by a committee representing the Association of British Chemical Manufacturers and various chemical institutions

This attempt at a compromise between the interests of the manufacturer and the views of many members of the medical profession has, however, met with severe criticism. Prof F L Pyman and other representatives of the fine chemical industry have pointed out that the scheme fails to provide the protection which the manufacturer in Great Britain requires if he is to incur the heavy expenditure required for research and development in this field, thus definitely discouraging the patenting of improved processes for the manufacture of known compounds and hindering the publication of the underlying scientific work. Moreover, the differentiation between chemical products according as they are intended or not for medical purposes involves logical absurdities and creates difficulties for the manufacturer which may be intolerable, and, by stultifying the purpose of the scheme, react against the public interest.

Differentiation between medical inventions and other classes of scientific inventions can only be logically defended to-day on a very narrow interpretation of science. On any broad view, medical science is only one of the ways in which science serves humanity. The contribution of the chemist, the physicist, the engineer, the biologist, the agriculturist, and others are no less important, and upon their efforts also the success of mankind's struggle to maintain its existence often depends.

To question the desirability of affording medical patents, medical inventions, or discoveries treatment distinct from that accorded to discoveries in other branches of science is not to assert that the present patent system is ideal or satisfies the requirements of industry, science, and society. On the contrary, Mr C C Paterson suggested in a memorandum printed in the British Science Guild's Report on the Reform of the British Patent System that we have seriously to consider whether the principles of the existing patent law are suitable to the modern conditions of industry, and particularly chemical industry, when progress depends less on discontinuous invention than on the continuous application of scientific research. If this question can be answered in the affirmative, there can be no convincing or logical reason for refusing to bring medical, biological, and agricultural products within the system. If, on the other hand, as is by no means impossible, our investigation leads to the conclusion that the principles upon which the patent law is based are obsolete, we are

faced with the responsibility of developing a new and alternative system in which medical and agricultural discoveries or inventions should receive a normal and logical treatment along with other classes of scientific discovery.

In its memorandum, the Medical Research Council discriminates between scientific discovery and invention, and recognises that, in the main, medical advances now come less from inventive ingenuity than from systematic scientific research. The arguments advanced against the patenting of medical discoveries are not altogether logical, and are so similar to those advanced in other quarters against the protection of scientific discoveries, that a strong suggestion is prompted that a solution to the problem of protecting scientific property might at least include a solution of the lesser problem of protecting medical discoveries. The growing evil of 'paper' patents drawn up in terms which cover whole fields of prospective discoveries has, as we have said before in these columns, led to serious doubts as to the suitability of our present patent law system to modern industrial conditions. No drastic modification of patent law could, however, be contemplated except through international convention. International discussions on the idea of protecting the right of scientific workers to participation in the profits arising out of their discoveries may at least assist in elucidating the whole situation, and provide an opportunity for opening up international discussions on the fundamental position of patent law, if required.

Unsatisfactory as the present position in Great Britain may be, premature action is unlikely to be beneficial. The advocates of 'dedicated patents' themselves recognise the impracticability of total abolition of patents in the medical field except by international agreement. As already urged, any discrimination between one branch of science and another in patenting is logically indefensible, on ethical grounds it may be invidious. Since it can only be effective by international agreement, it might be well to determine first the suitability of the practice of patenting for industrial needs under modern conditions, the possibility of extending some form of protection to all scientific discoveries which receive industrial application, and finally, the broad lines which any new system to supersede a patent system should take. From such discussions there should emerge a considered and scientific policy which, without discriminating between different sciences, would reconcile the requirements of industry and the encouragement of scientific discovery in ways affording the maximum public advantage.



### The Study of Wireless Principles

- (1) *Wireless a Treatise on the Theory and Practice of High-Frequency Electric Signalling* By L B Turner Pp xviii+528+31 plates (Cambridge At the University Press, 1931) 25s net
- (2) *Experimental Radio Engineering* By Prof John H Morecroft Pp v+345 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1931) 17s 6d net
- (3) *Foundations of Radio* By Rudolph L Duncan Pp ix+246 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1931) 12s 6d net

UNDER pressure of the abnormal conditions which prevailed in the world during the years 1914-18, the thermionic valve, born a few years before, successfully passed through its early life as a practical appliance in wireless communication. Its possibilities at both the transmitting and receiving ends of the link were appreciated, and it became evident that a revolution was taking place in the practice of the art. Such a change demanded new literature and textbooks, and Mr L B Turner was one of the first in the field with his "Outline of Wireless" published in 1921. This book presented in a clear and concise manner the fundamental principles of wireless communication as then practised, with an adequate description of the part played by the thermionic valve.

The volume now under review (1) represents the continuation of the author's aim to present an account of wireless theory and practice which should be readable by a competent electrical engineer who had not studied high-frequency phenomena. In extending the work to cover the progress of engineering achievement and scientific research during the intervening ten years, the book has grown from 195 to 528 pages, although it is significant of the economic conditions of our times that the price has only increased from 20s to 25s. In considering the size of the book, it may be questioned whether, for the sake of possible completeness, it is desirable to continue to include obsolescent matter dealing with plant and apparatus, the development and applications of which have given way to the valve. Chaps v and vi of the book, occupying sixty pages, deal with spark transmitters, arcs, alternators, and crystal detectors. Even the latter item of apparatus, once so popular among broadcast listeners, has receded into the background at recent radio exhibitions. In the compilation of an up-to-date textbook on a

rapidly advancing subject such as wireless communication, the time must come when it is necessary to relegate the historical development of the subject to a mere background in, say, an introductory chapter.

In the present case the introductory chapter outlines the basic properties of waves and their use for signalling purposes, and in Chap. II the author plunges straight into an analysis of the propagation of an electromagnetic disturbance. The study of this chapter by the average electrical engineer is not made easier by the use of two systems of units throughout, since most of the formulæ involved are given in parallel columns under the headings "Electrostatics", "Magnetostatics"—surely somewhat curious names for a consideration of high-frequency phenomena. Chap. III, dealing with "Propagation of Wireless Waves Round the Earth", was found to be very refreshing as a concise, if somewhat brief, summary of the state of this portion of the subject, freed from a consideration of the enormous mass of experimental data on field intensity measurements under various conditions. The fourth chapter gives the usual analysis of the behaviour of an oscillatory circuit under the influence of an impressed e.m.f. of either the damped or the undamped type. The analysis includes a consideration of the principles of the measurement of frequency and decrement, and also the behaviour of an aerial as an oscillatory circuit.

In Chap. VII the reader is introduced to the thermionic valve, and this and the succeeding four chapters, occupying 180 pages, comprise a detailed consideration of the valve and its applications as a rectifier, amplifier, and oscillator. The student is carried forward from an elementary discussion on thermionic emission and space charge effects to consideration of the action of the part played by the third and following electrodes, as exemplified in the modern triode, screen-grid valve and pentode. Attention is continually directed to the dimensions of the various quantities involved by giving typical values for modern valves and apparatus, but the main object here has been to present a detailed analysis of the features governing operation and performance. In places, such as Chap. X, it might be questioned whether the discussion has not been made unduly complicated, but the difficulties of dealing with this portion of the subject are well known and the reviewer is loth to criticise any attempt to give a generalised treatment free from the approximations which are usually made and often make the results inapplicable to any practical case.

The section on telephony devotes to the subject the fair amount of space which it deserves in view of its importance in our everyday life. A chapter on 'antennas' deals briefly with arrays and other directive systems, and refers to the use of such arrangements for direction-finding purposes, although it is doubtful if pp 459-460 would be easily understood by one not well versed in direction-finding. Discussion of the distribution of high-frequency currents in conductors is delayed until Chap xv, while a general analysis on filters follows. The last chapter discusses the atmospheric pulse as a continuous spectrum and refers to the periodogram analysis aspect of the subject. Lack of space has, apparently, prevented the author making any allusion to the large amount of experimental work conducted for several years past in the investigation of the origin and nature of atmospherics.

The photographic illustrations are concentrated in the centre of the book in the form of thirty-one plates. While the majority of these are excellent as illustrating views of apparatus and plant not normally available for inspection by the average student, it was, perhaps, scarcely worth while including Nos 3 and 16, illustrating a variable condenser and a receiving valve such as nowadays can be seen in any shop window.

Considering the size of the book, the mistakes noted are relatively few in number. It may be pointed out that at the time the book was written, the London broadcasting station was not in Oxford Street (p 6), and that the Poulsen arcs at Leafield (p 131) were replaced by a valve transmitter several years ago. The reviewer must also complain that he dislikes very much the author's habit of attaching extensive footnotes to many of the pages of text. Footnotes are permissible as references to literature or, occasionally, as afterthoughts occurring while the book is in the proof stage, but in general, they should either be embodied in the text or suppressed altogether.

These shortcomings, however, form a very small portion of the whole book, and if the author's purpose was to nurture his "Outline" into a comprehensive survey of the fundamental principles of wireless communication, he may be congratulated upon having achieved his object. The book may be recommended to all those serious students and engineers whose interest or occupation demands that they should delve somewhat more deeply into the subject than would be the case if they desired merely to increase their general knowledge of the applications of physical science. The general pro-

duction of the book, including the diagrams and mathematical symbols, is of the high quality only to be expected from such publishers as the Cambridge University Press.

In the preface to his book Mr Turner writes: "Particularly in high frequency work does a lack of prolonged practical experience make itself apparent. Proficiency with mathematical equations and circuit diagrams is indispensable, but is not sufficient to make the student effective as an engineer. He must manipulate the things whose idealised qualities are portrayed in the circuit diagrams, and often a rather long apprenticeship proves necessary." To aid the student in passing through this apprenticeship stage, Prof J. H. Morecroft's book (2) should prove invaluable, and so far as is known, this is the first available textbook directed specifically to the teaching of radio principles in the laboratory. An introduction of thirty pages surveys very briefly the field of radio measurements and gives many practical hints on the acquisition and calibration of suitable apparatus. The remainder of the book is then devoted to fifty-one experiments, each having a clearly stated object and designed to illustrate some particular phase of radio frequency phenomena and to make the experimenter familiar with the use of all types of apparatus. The statement of the object of each experiment is followed by an analysis of the quantities involved in such a manner as to give to the student a realistic view of the theoretical principles with which it is assumed he is already familiar. Instructions are given as to the best method of dealing with the results of the experiments so as to deduce as many quantities as possible. There is no doubt that this book meets a real demand in supplying a kind of laboratory manual for the radio engineering student, and the author is to be congratulated on the production of this companion volume to his already well-known "Principles of Radio Communication", the second edition of which was reviewed about three years ago\*. The student who works conscientiously through either Turner or Morecroft to learn his fundamental principles, and also performs all the experiments described in the book now under review, will indeed be well equipped to begin his career as a qualified radio engineer.

The last book (3) under review deals not with radio communication as such, but with the elements of electricity and magnetism, a knowledge of which is usually assumed by the author of any book on wireless principles. In the course of seven

\* NATURE, vol 122, p 567, 1928

chapters the author deals with the elements of electrostatics, magnetism, electromagnetic induction, resistance and Ohm's law, and the construction and use of primary cells. The eighth chapter gives some information on sound vibrations and waves, while Chap ix, headed "Preparatory Mathematics", provides a short summary of arithmetical procedure. The explanation of principles throughout the book is, in general, quite clear, and the reader is helped by some easily understood graphical illustrations. The treatment is not, however, carried to the stage of dealing with alternating currents, a knowledge of which will be essential before the reader can proceed to the consideration of the production of electrical oscillations and wireless waves. On the subject of elementary electricity and magnetism, the reviewer was not aware of the need of a further book on this subject, and at the published price of 12s 6d this volume would seem to be somewhat dear.

R. L. SMITH-ROSE

### Early Europe

*The Early Age of Greece* By Sir William Ridgeway  
Vol 2 Edited by A. S. F. Gow and D. S. Robertson Pp xxviii + 747 (Cambridge At the University Press, 1931) 30s net

IT is not usual for two volumes of the same work to be published thirty years apart. In Sir William Ridgeway's case the reason is that he began to write about the prehistory of Greece and found himself drawn into writing a prehistory of Europe, for the wide range of his theories led him to consider one district after another, Illyria, Italy, Central Europe, Ireland. The material to be studied was vast and constantly increasing, the angles from which he studied it were many, archaeological, sociological, religious, and literary. It is not to be wondered at if it grew unmanageable, especially for one of advancing years and failing eyesight. A lesser man would have given up the task altogether, but Ridgeway struggled on, wrote two or three lesser works dealing with fragments of his material or with subsidiary problems, and finally left behind at his death in 1926 an immensity of half-written work, in all stages from notes to proof-sheets, from which at last a selection has been published by the editors of this volume. Nearly seven hundred and fifty pages, illustrated with 158 figures, are by no means a contemptible fragment, we may judge how enormous the complete work would have been if it had ever seen light in the form the author meant it to have.

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As Mr. A. J. B. Wace points out in a short but excellent introduction, much of what now appears was written thirty years ago, and must be judged accordingly. There are echoes in it of controversies now dead and buried, and also, it must be admitted, passages which are instructive chiefly as showing what strange things passed for sociological evidence at the beginning of this century. This is particularly the case with the first chapter, "Kinship and Marriage". Ridgeway's general theory was that Greece was inhabited in very early times by a matrilineal population, of the race he terms Pelasgian, who were the authors of the Mycenaean culture on the mainland and were invaded by the Achaeans, a fair, tall people from the north, whose social structure was of the patrilineal type and whose nearest kin were the Kelts. It is difficult to say whether Ridgeway shows more acuteness here in refuting the opinion of M'Lennan that mother-right existed in historical Greece or lack of critical judgment in the arguments he advances for its presence among the 'Pelasgians'.

With regard to the other chapters, "Murder and Homicide", "Fetish, 'Totem', and Ancestor", and "Ireland in the Heroic Age", much the same criticism may be made, with this difference, that the material is more largely archaeological, and when archaeology was his subject, Ridgeway had an almost unique power of making the dullest details interesting. To say that his interpretation is often doubtful is not to deny that he gives his critics something definite and clear with which to agree or disagree. About half his ideas were magnificently right, and for these we may honour his memory and pass quietly over the other half, which were enormously wrong.

H. J. ROSE

### Dr. Huxley and Mr. Arnold

*Brave New World a Novel* By Aldous Huxley  
Pp v + 306 (London Chatto and Windus, 1932) 7s 6d net

IT is difficult to resist the conclusion that the writing of 'Utopias' is far more entertaining than reading them. This is probably due to the fact that the planning of a novel of the future gives an author an enhanced sense of power unobtainable from a novel of the present. The present is too full of the past not to limit that pleasant sensation, which is probably why so powerful a creator as Mr. Wells turned more than once to the future for his material.

It was inevitable that Mr. Aldous Huxley should sooner or later write a novel of the future. "Brave

R. I.

New World" is his second-best book, for he will never surpass "Antic Hay". It proposes to describe a scientifically organised world, in which, however, one cannot imagine any scientist of to-day being able to live and work successfully. It is throughout a parody of the scientific point of view—shifting it ever so slightly but sufficiently towards the ridiculous—coupled with an exposition of Mr Huxley's objections to what he conceives the scientific point of view to be. The reasons for these are two, of which the second will be described later.

In the first place, biology is itself too surprising to be really amusing material for fiction. If one wrote to-day a plain description of the work of Dr Butenandt on the male sex hormone, it would probably seem funnier than Mr Huxley's detailed opening chapter on the "Central London Hatchery and Conditioning Centre", where humanity is raised 'on model factory lines. But never mind. What happens to these Alphas, Betas, Gammas, Deltas, and Epsilons, who are, of course, people, produced and conditioned and reared all nicely class-conscious and contented?

Mr Huxley's genius here reveals itself. he knows their jokes, and they *are* funny, he also knows their sorrows and a cunning method for dealing with them, the ingestion of a pleasant dream-producing narcotic called 'soma'. He knows their pleasures, of which the foremost is promiscuous intercourse without fertilisation. Here he makes a slight mistake, for no young lady six hundred years hence would wear so primitive a garment as a Malthusian belt stuffed with contraceptives when a periodic injection of suitable hormones would afford her ample protection. But on mass entertainment, such as the 'Feelies'—heirs to 'Talkies'—he is quite sound.

In his search for dramatic relief Mr Huxley follows Voltaire. Borrowing from him the idea of "L'Ingénu", a nice, simple savage, he provides one, a poor boy born mistakenly of a European father and mother, the latter a Beta-minus and all named Linda, who had got lost on an exploratory excursion to the New Mexican reservation where Indians were allowed to remain on sufferance. While Linda here relapses into a horrible state of pre-scientific squalor, her son John discovers the works of W Shakespeare. Henceforth his speech is that of the bard.

Now, however, a terrible thing happens which brings us back to the second reason for saying that Mr Huxley is unable to do justice to the scientific point of view.

The savage is brought back to his kind in Europe and goes berserk in their brave new world. That is nothing. The terrible thing is this. Mr Arnold appears once more and goes berserk on Dr Huxley. (Everyone knows that Mr Huxley is the grandson of T. H. Huxley. He is also the great-nephew, I believe, of Matthew Arnold, and therefore the great-grandson of 'Arnold of Rugby'.)

Dr Jekyll and Mr Hyde are nothing to Dr. Huxley and Mr Arnold. Mr Arnold is always doing it. He did it in "Point Counter Point", he does it in "Brave New World". Dr Huxley, who knows and cares about biology and music, science and art, is once again ousted by this double of his, morbid, masochistic, medieval-Christian Mr Arnold takes charge of the last chapter of "Brave New World". The result is distressing. Nevertheless, this is a very great book.

CHARLOTTE HALDANE

#### Lavoisier

*Lavoisier* By J. A. Cochrane. Pp. xiii + 264 + 8 plates. (London: Constable and Co., Ltd., 1931.) 7s. 6d. net.

THE great majority of biographies may be divided into two classes: those that tell us what a man did, and those that show us what a man was. Mr Cochrane's life of Lavoisier is a very competent example of the former, in which the story flows smoothly and evenly, while a due sense of proportion is maintained throughout. If we are left at the end with the feeling that we still do not know what manner of man Lavoisier was, we must nevertheless gratefully acknowledge that the main facts of his life and work have never before been so adequately described in the English language. It has, indeed, been a reproach to us and to our American cousins that, while the adjudication between the relative claims of Lavoisier, Priestley, Cavendish, Watt, and others has always excited considerable interest among us, no complete or even moderately complete biography of the great Frenchman had been written in our tongue. This omission is all the more remarkable in that many historians of chemistry must have been in a position to repair it with very little additional labour to themselves. Happily, the reproach is now expunged, and though Mr Cochrane would probably be the first to admit that the definitive biography is still to be written, he deserves our warmest thanks for his clear and unbiased account of Lavoisier's career.

Though this is Mr Cochrane's first appearance

as a historian, he is already widely known as the author of several admirable little books on elementary science, in which his interest in the history of chemistry shows itself very plainly. The present book proves that his ability to write simply and attractively is allied to sound historical sense and critical judgment, and though he modestly says that he had hoped another pen than his own would have undertaken the task he set himself, most readers will feel that, within the same limits, no one could have achieved a more satisfactory result. He is at his best in plain narrative, as, for example, in his account of Lavoisier's early life and in his description of the circumstances of the arrest, trial, and execution, while his summary of Lavoisier's manifold scientific activities contains much that will be new, even to chemists.

On the question of Lavoisier's integrity in his claims to priority in the discovery of oxygen and of the composition of water, Mr. Cochrane sees no reason to dissent from the usual conclusion that he cannot be exonerated from the charge of attempting to pick the brains of Priestley and Cavendish, indeed, the facts are no longer in dispute, and one can only regret this 'moral twist' in a character that is in so many ways both noble and charming. We may frankly admit that Lavoisier was indebted to Priestley, to Beccaria, to Bayen, and to many others, and that he refused to acknowledge his indebtedness with any degree of completeness, but his unruffled calmness in the period of the Revolution and the bravery with which he faced the guillotine on May 8, 1794, go far to cancel the lapse. General nobility of character is not infrequently accompanied by curiously inexplicable shortcomings, and in the final reckoning Lavoisier's unselfish labours in the public welfare, not to mention his strict honesty in the *Ferme*, must surely be taken into account.

It is interesting to learn from Mr. Cochrane's pages that Lavoisier's marriage, which provided him with an ideal companion for his life and work, was agreed upon as a casual matter, undertaken to oblige his friend Paulz. The Controller-General, a man of fifty, had conceived an infatuation for Paulz's daughter Marie Anne Pierrette, a pretty child of thirteen with blue eyes, brown hair, and rosy complexion. Her father strongly objected to the match, and to put an end to a difficult situation (for the Controller-General was an extremely influential man), he suggested to Lavoisier that the girl would form a suitable bride for himself. Lavoisier obligingly consented, and the marriage took place in December 1771. Mme Lavoisier

brought her husband a *dot* of 80,000 livres, while his father gave him 250,000 livres as a wedding present. Since his mother had already left him 170,000 livres, the young couple entered upon their new life in very comfortable circumstances, and Lavoisier was able to carry on his scientific researches free from the shadow of financial cares.

Mr. Cochrane's story of the last few years of Lavoisier's life is an excellent, if sombre, piece of work. He states the facts without emphasis, but in so telling a manner that here, for a short time, we begin to feel that we see the man himself. Doom was in the air, and Lavoisier knew it, but he proceeded imperturbably with his experiments and refused to be frightened into giving up possessions that were legally his. He had sympathy with the Revolution in its early days, and never attempted to avoid payment of the heavy levies that the government made upon the wealthier classes, though he was careful to see that he paid no more than the law could properly demand. When at length he was arrested, with other members of the *Ferme*, he could no longer carry out original research, but he proceeded steadily with the composition of his "Memoirs of Chemistry." By the end of April 1794, the first two volumes were ready for the printer, and one of the last tasks of his life was to correct the proofs. The sands were now quickly running out, and in a few days Lavoisier's head fell on the scaffold, the victim immediately preceding him being his father-in-law Paulz, then an old man of seventy-five.

It is difficult to gauge the loss that science suffered through the untimely death of one of her most brilliant exponents, but Mr. Cochrane is not over-estimating the probabilities when he says that, if his wonted success had continued to attend him in the other problems he intended to explore, he would have anticipated many of the discoveries of the nineteenth century. Like Mr. Cochrane, we think it a strange fact that although Lavoisier was at the time of his death and for at least fifteen years before it one of the most eminent men in France, the general historian usually does not think it worth while to make any mention of him. Perhaps this little book may secure for Lavoisier his rightful position in the history of France, his position in the history of science is already established. The statue in the Rue Tronchet, miraculously undamaged by the German shell that shattered the end of the Madeleine, is a symbol of one who can never be dislodged from the halls of intellectual achievement.

E. J. HOLMYARD

## Short Reviews

*Théorie des fonctions algébriques et de leurs intégrales*  
Par Paul Appell et Prof Édouard Goursat  
Deuxième édition, revue et augmentée par Pierre  
Fatou Tome 1 *Étude des fonctions analytiques  
sur une surface de Riemann* Pp xxxv + 526  
Tome 2 *Théorie des fonctions algébriques d'une  
variable et des transcendentes qui s'y rattachent ,  
fonctions automorphes* Pp xiv + 521 (Paris  
Gauthier-Villars et Cie, 1930 ) 200 francs

VOL 1 of the present treatise is a revised edition of Appell and Goursat's well-known "Théorie des fonctions algébriques et de leurs intégrales" The second volume, contributed by the late M. Pierre Fatou, is an introductory but fairly comprehensive treatise on automorphic functions One of the most valuable features in the early part of this volume is a new and remarkably simple proof of the theorem, that a group of real linear transformations which has no infinitesimal transformation is properly discontinuous A determination of the fundamental domains of Fuchsian and Kleinian groups follows, and then the chief known properties of Fuchsian and Kleinian functions, and an account of the theta functions The only example of a group considered in detail, however, is, as in many previous treatises on automorphic functions, the modular one No insuperable difficulty exists in the way of extending this list considerably The whole treatise is written in clear and masterly style, it forms an admirable introduction to the classical work of Klein and Poincaré

*The Soil and the Microbe an Introduction to the Study of the Microscopic Population of the Soil and its Rôle in Soil Processes and Plant Growth* By Prof S. A. Waksman and Prof R. L. Starkey (The Wiley Agricultural Series) Pp xi + 260 (New York John Wiley and Sons, Inc., London Chapman and Hall, Ltd., 1931) 17s 6d net

"THE Soil and the Microbe" is a difficult book to review, for, knowing how much soil microbiology owes to the researches of the two authors, one is led to expect a high standard of excellence in a book from their pens, and this, unfortunately, is not the case Though apparently written for the elementary student or inquiring farmer, yet there is a doubt as to whether such readers would find the way smooth for a real understanding of the principles of soil biology To illustrate the unevenness of planning, the carbon dioxide cycle is first discussed in the foreword, then the nitrogen needs of the plants are mentioned on p. 14, where it is stated that these needs are furnished by the addition of inorganic substance or organic forms of nitrogen such as urea or guano, but it is not until much later in the book that there is any mention of the reason for supplying nitrogen in the form of urea or guano, or precisely what rôle microbes play in the transformation of such substances

The volume, however, should not be condemned out of hand, for undoubtedly it has its points, in that

it summarises a great deal of our knowledge concerning the chemical changes going on in the soil and is well illustrated, though Fig. 5 should undoubtedly be suppressed in any future edition, for it is either unintelligible or, if intelligible, incorrect

*Einführung in die Zytologie* Von Prof. Lester W. Sharp Mit Genehmigung des Verfassers aus dem Englischen übersetzt und vollständig neu bearbeitet von Prof. Robert Jaretsky Pp 733 (Berlin Gebrüder Borntraeger, 1931) 52 50 gold marks

SHARP'S "Introduction to Cytology" was first published in 1921 The present work is a translation and amplification of the second edition, which appeared in 1926 The considerable additions made by the translator, Prof. Robert Jaretsky, refer chiefly to the more recent literature, and are indicated by a 'J' on the margin of the page Discussions are added on protoplasmic inheritance, genic changes, mitogenetic rays, and various other topics, leading in some cases to a revision of the original author's point of view on such matters as the nature of the spindle fibres Some three hundred additional cytological papers are considered

The present work is a very good account of modern plant cytology, with reference not only to flowering plants but also to all the other plant groups By way of comparison, numerous references are made to the conditions in animal cells in connexion with such topics as Golgi apparatus, gametogenesis, syngamy, parthenogenesis, and chromosome structure This useful work for students and investigators ends with an extensive bibliography and a carefully compiled index

*La téléphonie* Par Robert Dreyfus (Collection Armand Colin section de physique, No 125) Pp 199 (Paris Armand Colin, 1931) 10 50 francs

ALTHOUGH the use of the telephone in everyday life is continually extending, yet the theory of its working is known to very few of its users Some of them know that it is connected with the name of Graham Bell, but beyond this their knowledge does not extend The object of this little book is to fill up the gaps in the knowledge of an otherwise well-educated man The subject is much wider than is commonly understood by the public In a book of this size, therefore, it is only possible to give a very brief account of the physical and mathematical difficulties that had to be overcome before the telephone attained its present perfection

To anyone with a knowledge of differential equations, the few mathematical formulæ given will be readily understood Other readers can omit the mathematics and yet gain quite an accurate knowledge of the telephone and of the transmission of electric signals through wires The description of automatic telephony is good, and so also is the account of the great advances made in long-distance transmission The purchaser of this book gets excellent value at a very small outlay

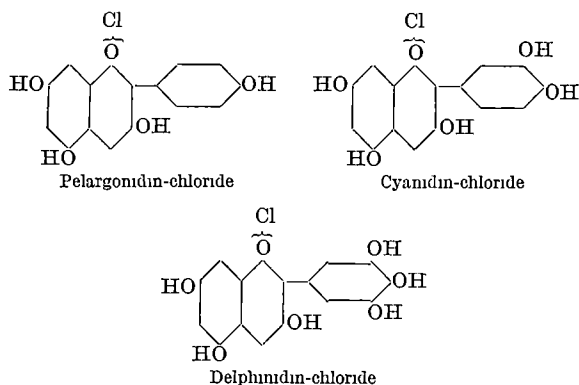


## Genetical and Biochemical Aspects of Anthocyan Pigments

By MURIEL WHELDALE ONSLOW

SINCE the publications of Willstatter and his co-workers upon anthocyan pigments during the years 1913-16, other investigators have turned their attention to this field of research. Though the later work has scarcely introduced any fresh facts of fundamental importance about this group of pigments beyond those already presented by Willstatter himself, yet it has given us much additional knowledge as to the distribution of the individual pigments among the flowering plants, especially in connexion with colour varieties of various species. The object of this article is to indicate how the chemical identification of the pigments may be correlated with certain broad aspects of the genetics of flower colour and the metabolic reactions connected with formation of anthocyan pigments in the plant itself.

From Willstatter's investigations the fact emerges that there are three commonly distributed anthocyan pigments—pelargonidin, cyanidin, and delphinidin.



Cyanidin and, especially, delphinidin appear also, according to Willstatter, in various plants as methyl ethers, certain hydroxyl groups being replaced by methoxyl groups. The positions, however, of the methoxyl groups were not defined precisely. Moreover, though the sugars of the glycosidal pigments were identified, the points of attachment of the sugar groups were not definitely ascertained.

The more recent investigations<sup>1</sup> include those of Karrer in Zurich and Robinson in Great Britain. Karrer and his co-workers have determined the positions of the methoxyl groups in such pigments as are methylated, also to some extent those of the sugars. Robinson and his co-workers have synthesised a number of benzopyrylium compounds, some of which have been identical with the natural pigments, and thus they have confirmed certain of Willstatter's conclusions. They have defined in many cases the position of the sugars and have synthesised some naturally occurring glucosides. Moreover, by elaboration of tests, they have made it possible to identify with relative ease various known anthocyan pigments in any given material.

For the purposes of this article, the presence of methoxyl groups and the kind and the position of the sugars are of subsidiary importance. The points at issue are concerned chiefly with the occurrence of the three main pigments.

Let us turn first to genetical problems. In the majority of horticultural plants which have been long under cultivation it is difficult to determine which species have been concerned in their origin. In a few cases, such as the sweet pea, Chinese primula, and snapdragon, it is relatively simple.

In the snapdragon (*Antirrhinum majus*) the pigment of the magenta flowers is cyanidin, and there is no doubt that this is the pigment of the original, wild, magenta-flowered type. About thirty years ago the most important of recent 'breaks' in *Antirrhinum* appeared—rose doré—a variety now catalogued under many names, such as coral, salmon pink, etc. Genetically, rose doré is hypostatic (recessive) to magenta, and there is a factorial difference. Though not yet isolated, there is no doubt that the flowers of rose doré contain pelargonidin. The stems, petioles, and leaves often develop pigment too; in the original magenta type it is cyanidin, in the variety, pelargonidin. Here, then, we have the creation from a plant producing cyanidin of another which produces pelargonidin instead. Moreover, it should be realised that the power to produce one or the other pigment may be limited to the epidermal layer of the plant. In some horticultural types and varieties two or more pigments may be present together, though one usually predominates. Such complications are eliminated from the present discussion, especially as the segregation of pigments is usually complete.

Now a similar case to that of *Antirrhinum* has long been obvious from Willstatter's original results. He found the blue cornflower (*Centaurea Cyanus*) to contain cyanidin, its pink variety, pelargonidin. Though the genetics of the cornflower may not have been demonstrated in a practical way, it is clear to a geneticist that there is a factorial difference between blue and pink, and that pink is hypostatic.

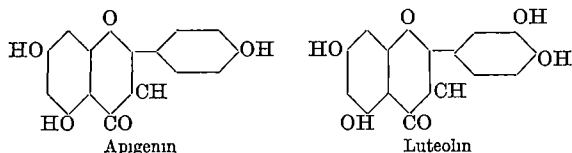
Another case is the blue flower of *Hyacinthus orientalis*, which contains delphinidin. Though the origin of many horticultural bulb plants is doubtful and has often been kept secret, one must suppose the colour of the original *H. orientalis* to have been blue. The pink variety contains, again, pelargonidin, and cyanidin is claimed for intermediate varieties. In Nature, too, a pink variety of the wild hyacinth (*Scilla nutans*) may be found occasionally. In the latter we have undoubtedly a phenomenon of variation alone. In blue *Campanula* delphinidin is reported, and we cannot doubt that the original type was blue. Again, a hypostatic pink variety exists and contains pelargonidin. Thus from a delphinidin type also have arisen varieties containing pelargonidin and, sometimes, cyanidin. This true red (pelargonidin)

group of the geneticist, hypostatic to cyanidin and delphinidin groups, is obviously present in a number of cultivated plants, such as the sweet-william, Chinese primula, stock, phlox, carnation, sweet pea, and *Clarkia*. To determine when it is a true sport (*Antirrhinum*, Chinese primula, and sweet pea) and when it may result from species crossing is, however, difficult.

Now the interesting question arises whether, conversely, starting with pelargonidin, the power to form cyanidin may arise by variation, or, starting with cyanidin, the power to form delphinidin (all pigments again may be limited to the epidermis). Evidence in support of this supposition is difficult to acquire. The varieties of types under long-standing cultivation may show, among them, all three pigments, but since there is often uncertainty as to the outward appearance of the original type, so there is also uncertainty as to its pigmentation. Thus in the sweet pea, of which the original type resembled 'Purple Invincible' and in the Chinese primula, where the original type is known, we have not yet been informed as to their pigmentation. Such types may have contained either delphinidin or cyanidin, or both. In the aster, chrysanthemum, gladiolus, gloxinia, phlox, tulip, and others the problem is even more difficult. There is, however, a case where it would appear that a pelargonidin type has given rise to a cyanidin variety. Such is the garden nasturtium (*Tropaeolum majus*). The orange-red type contains pelargonidin, purple-red varieties, which are hypostatic to the type, contain cyanidin.

Thus, summing up, we may say that loss of one series of factors leads to loss of power of oxidation in the phenyl ring, so that instead of delphinidin, cyanidin is formed, and instead of cyanidin, pelargonidin. There is little doubt, too, that the reverse effect takes place. Thus we may express as the loss of a series of factors which inhibit oxidation, in other words, loss of another series of factors leads to increased oxidation. So that, instead of pelargonidin, cyanidin may be formed, and instead of cyanidin, delphinidin.

The occurrence of a more oxidised pigment in a hypostatic variety is also to be found in the inheritance of flavone pigments in *Antirrhinum*. Two varieties, ivory and yellow, exist, and of these ivory contains apigenin, yellow, luteolin.



There is a factorial difference between the varieties, and ivory, moreover, is epistatic (dominant) to yellow.

Now the question arises as to what may be the significance of the facts so far quoted. I have already pointed out<sup>2</sup> that evidence in general indicates the origin of anthocyan pigments from condensation of residues of amino-acids after de-amination.

There are three classes of aromatic compounds which may be synthesised from such residues, the flavone pigments,<sup>\*</sup> the anthocyan pigments, and the tannins. Flavone pigments are universally distributed in the tissues under all conditions. Hence it is likely that they are products of de-amination and condensation under the usual conditions of growth and development. Anthocyan pigments are only formed under special conditions. Finally, the tannins only arise in a certain type of plant.

Upon the precise reactions of condensation leading to the formation of anthocyan pigments it is idle to speculate. The phenyl ring, we would assume, has its origin from tyrosine or phenyl-alanine. The phloroglucinol ring, possibly, from short-chained residues of aliphatic amino-acids, or again, possibly, from hexose. By oxidation, either by enzymes or chemical agents, hydroxyl groups are readily introduced into the phenyl ring in a position *ortho* to that of an existing group. Clearly, the occurrence and segregation of pelargonidin, cyanidin, and delphinidin is a matter of loss or gain of power of oxidation or reduction.

It is obvious from the foregoing that the wide range of coloration in flowers is to some extent due to the pigment involved. Summarising on very general lines, one may say that pelargonidin flowers (though these are rare in natural species) incline to shades of scarlet, cyanidin flowers to shades of crimson or purple-red, delphinidin flowers to shades of blue or purplish-blue. But there are many exceptions to such a classification. The scarlet poppy, the magenta rose, and the blue cornflower contain the same pigment, cyanidin. In the Chinese primula, two varieties, blue and magenta, exist having the same pigment.

The idea has prevailed for a century or more that the colour of a flower may be changed by the presence of various substances in the petals, such as acids, alkalis, iron salts, and other compounds. Willstätter showed that the blue colour of the cornflower is due to a potassium salt of cyanin. He also constantly emphasised his view that the colour of the flower or fruit may be modified by accompanying substances in the tissues. Recently, Robinson<sup>3</sup> has brought forward the idea of the existence of co-pigments in many cases, that is, a variety of substances occurring in the plant which, entering into loose combination with the anthocyan pigments, modify their colour. Such a substance may represent a factorial difference between varieties.

So much for variation in colour. A suggestion can also be made here in connexion with the cause of albinism. In *Antirrhinum* there are two forms of albino in regard to anthocyan pigments, namely, ivory (including the hypostatic yellow) and white. The ivory contains flavone pigment, the white has none. Ivory and white (of correct constitution) crossed together will produce the magenta type. That is, ability to form flavone pigment is one essential for anthocyan production, the other is a factor borne by white. Such white-flowered plants are always stunted and poorly developed.

\* The expression flavone pigment is collective and includes both flavone and flavonol.

They contain no flavone pigment, and hence can never form anthocyan pigment, though not necessarily derived from the yellow pigment, anthocyanin production depends on its presence

It is reasonable to suggest that some aromatic component of the protein is entirely absent from the white-flowered plants. Hence neither anthocyan nor flavone pigment can be formed. A different cause for albinism must be postulated for the ivory variety, though there is no indication at present as to what this may be. Two kinds of albino, containing between them the elements essential for the production of anthocyan pigment, occur in the sweet pea and many other plants, but in these cases they are usually indistinguishable to the eye.

There is yet another form of variation among cultivated plants of rather a different nature from those we have already considered. In this the type has flowers, either free from anthocyan pigment or only slightly tinged, whereas the variety is fully coloured. That is, loss of a factor gives rise to a fully pigmented, hypostatic variety. The origin of the red variety of the sunflower (*Helianthus annuus*) from the yellow type affords an example, so also does the purple-leaved (copper) beech.

Just such a phenomenon as the above mentioned, that is, the appearance or non-appearance of anthocyanin, is characteristic of the flowering plants as a whole. The flowers of certain species form very little or no anthocyan pigment, while it is abundant in the flowers of others. It is difficult to make any suggestion as to what may be the chemical interpretation. It is conceivable that presence of sugar in the tissues may prevent the de-amination in inhibited types, or that excess of sugar may bring about condensation, as is probably the case when anthocyanin develops as the result of artificial sugar feeding. If so, then the factors concerned are correlated with some metabolic cycle other than that of pigmentation.

Before we leave the above variation among species one more point may be made, namely, the resemblance of the phenomenon to the distribution of autumnal anthocyan pigment in leaves, for the latter also is present in some species and absent from others. In fact, the autumnal coloration of leaves may be regarded as quite analogous to the pigmentation of petals. In each case the organ is senescent, it has ceased to assimilate and is gradually becoming detached from the parent plant. Desiccation is enhanced in the petal by the unprotected condition of the tissues against loss of water, in the autumnal leaf by the decreased water absorption from the soil owing to low temperature. An autumnal leaf developing anthocyan pigment can be regarded as a petal of very coarse texture. When anthocyan pigments are not developed it is yellow, as is also a petal which owes its colour to plastid pigment and has not the power to form anthocyan pigment.

Finally, some additional points of interest are connected with a consideration of the relationship of the particular anthocyan pigment formed in a plant to the accompanying flavone pigments and

other aromatic compounds in the same plant. If we ascertain the relative frequency of occurrence of cyanidin and delphinidin among the plants investigated, we find the values to be approximately as follows

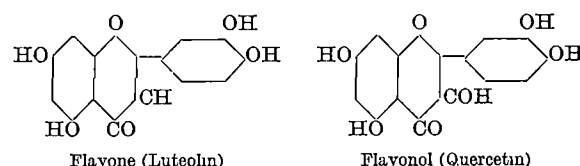
|                                               | Plants containing cyanidin | Plants containing delphinidin |
|-----------------------------------------------|----------------------------|-------------------------------|
| Where isolation of pigment has been achieved  | 12                         | 12                            |
| Where pigment is identified by reactions only | 61                         | 60                            |

Thus plants appear to form an anthocyan pigment having the three hydroxyl groups characteristic of gallic acid as frequently as one with the dihydroxy grouping characteristic of catechol.

Now an outstanding fact of importance in connexion with aromatic compounds in the flowering plants is the distribution, in about 63 per cent of the natural orders, of the catechol oxidase system involving the presence of substances containing the dihydroxy grouping of catechol. From the remaining plants catechol derivatives are absent, pyrogallol compounds being frequently formed instead.

For all cases available I have made a record of the type of anthocyanin formed and the presence or absence of the catechol oxidase in the same plant. It is clear from the outset that the presence of the latter cannot always be associated with formation of cyanidin and its absence with formation of delphinidin, since the frequency of occurrence of cyanidin to that of delphinidin is 1.1, while that of oxidase to non-oxidase plants is almost 2.1. Such a conclusion is also apparent on analysis of the cases of species producing delphinidin, instead of being universally without oxidase, some contain oxidase, while others are non-oxidase plants. Hence on broad lines there is apparently no indication that plants producing catechol compounds always produce cyanidin.

Nor can any consistent relationship be detected between the anthocyan and flavone pigments of individual plants. Thus, for example, both flavone and flavonol pigments occur in plants



But all natural anthocyan pigments, on the simple reduction relationship, are related to flavonols, none to flavones.

In *Rosa gallica* and the wallflower there is a certain symmetry in the relationship of flavone to anthocyan pigment, the former being quercetin, the latter cyanidin, yet in other cases, such as *Delphinium* (kämpferol, delphinidin), *Viola* (quercetin, delphinidin), and *Antirrhinum*, there is no such connexion.

In varieties of *Antirrhinum* the four pigments, cyanidin, pelargonidin, apigenin, and luteolin, are formed. But there is no correlation between their presence in the epidermis. Cyanidin or pelargonidin can be found either with apigenin or luteolin.

General considerations would suggest that possibly in the flower flavone pigments result from

de-amination connected with growth and development, anthocyan pigments with de-amination connected with senescence.

<sup>1</sup> The investigations of Karrer and his co-workers are published in *Helv. Chim. Acta*, those of Robinson and his co-workers in *J. Chem. Soc. and Biochem. J.* Details of the data on genetics can be found in the *J. Genetics* and Onslow's "Anthocyanin Pigments of Plants".  
<sup>2</sup> *NATURE*, 128, 373, Aug. 29, 1931.  
<sup>3</sup> *Biochem. J.*, p. 1687, 1931.

## The Eruptions in the Andes

By Dr CHARLES DAIVSON

EARLY in the morning of April 10, eruptions began in several volcanoes of the southern Andes, most of which were supposed to be dormant or but rarely in action. The volcanoes affected, from north to south, are Tupungato, Overo, Tinguirrica, Peteroa, Descabezado, Las Yeguas, and Quizapu. Their heights diminish southwards, from 21,810 ft for Tupungato to 11,342 ft for Las Yeguas. All of them were in action simultaneously, though the distance that separates the extreme mountains is about 200 miles.

The principal feature of the eruptions is the great amount of the solid materials ejected. Loud explosions were heard at Santiago on the west side, and throughout the department of San Rafael on the east side, one hundred miles or more from the nearest volcano. But they were evidently not to be compared with those during the eruption of Krakatau in 1883, the sounds of which were heard at several places more than 2000 miles from the island, and at one place 2968 miles distant. Some observers in an aeroplane crossed the great crater of Las Yeguas (apparently on April 12). Every half-minute, loud explosions occurred within it, and blocks weighing many tons were thrown upwards more than 200 ft. These, it was said, gave the impression of being pulverised in mid-air.

During the three days of activity—the eruptions had almost ceased on April 13—all the towns near the volcanic zone were in a state of semi-darkness owing to the steady fall of fine dust and ashes. On the west side, the country from Santiago to Talca was covered with a layer of whitish dust, in places more than two inches deep. On the east side, the fall was much heavier. In the department of San Rafael, the layer of dust was a foot in depth, in other places more than two feet, and in one nearly three feet, so that trains were stopped from running. Even at Montevideo, about 850 miles from the nearest volcano, there was a steady fall of dust for many hours. Over Buenos Ayres (730 miles), it is estimated that more than 3000 tons of debris have fallen. The whole country there is coated with grey dust, so that cattle have to be fed with hay and artificial foods. Even if the average thickness of the dust over the whole area of deposition were no more than one-tenth of an inch, the total volume of the fallen dust would be about five cubic miles.

Several villages in the province of Mendoza were shaken by earthquakes, the stronger, no doubt, among many hundreds felt in the neighbourhood of the volcanoes. The shocks that accompany a volcanic eruption, though sometimes destructive

within a small area, are seldom felt more than a few miles from their origins. Occasionally, as in Hawan in 1868 and Sakura-jima in 1914, a tectonic earthquake strong enough to be registered all over the world may occur in the immediate neighbourhood of the volcano, but such disturbances are rare.

About one hundred years ago, on Feb. 20 1835, an earthquake of somewhat similar type overthrew Concepcion, and with it a long stretch of the Chilean coast was uplifted, in one place by 10 ft. One month before this, as Darwin describes in his great memoir, "On the Connexion of Certain Volcanic Phenomena in South America",\* eruptions occurred in three volcanoes, Osorno, Aconcagua, and Coseguina, all beginning within six hours. The first two mountains are separated by 550 miles. The third is so distant from either that, as Darwin says, we cannot be too cautious in assuming that the phenomena were connected. At the moment of the Concepcion earthquake, the volcanoes of Osorno and Minchinmadom, 150 miles apart, burst into action. Some months later, on Nov. 11 of the same year, a severe earthquake occurred at Talcahuano, the port of Concepcion, and on the same day, Osorno and Corcovado, separated by 205 miles, burst into violent action.

To us at a distance, a question of great interest is whether the eruptions will be followed in due time by such wonderful sunsets as were observed all over the world for months after the Krakatau eruption of 1883. With regard to the amount of dust projected into the atmosphere, there can be little doubt. The question is whether enough could rise to heights of from eight to ten miles. As Capt. Cave remarks in a letter to the *Times* (April 14), the explosions seem to have been less violent than those of Krakatau. On the other hand, the height of Krakatau was 2623 feet, while the Andean volcanoes rise from two to three miles higher. On April 13, Capt. Ralph Wooten, the U.S. Air Attaché at Santiago de Chile, flew across Quizapu at an altitude of 14,000 ft. He estimated that the smoke column was then reaching 5000 ft. above the crater, but he considers that, on April 10, at the moment of greatest activity, it must have risen to a height of 30,000 ft. If this estimate is correct, or nearly so, it seems possible that, within a few months, sunset glows may be visible in Great Britain. The eruption of Krakatau, it will be remembered, occurred on Aug. 26–27. The sunset glows were not observed in England until the end of November.

\* *Trans. Geol. Soc.*, vol. 5, pp. 601–631, 1840.

## Obituary

MR RICHARD SOUTH

MR RICHARD SOUTH was born in July 1846 at Cochran Terrace, Marylebone, the site of which has long since been occupied by the old Great Central Railway. Little is known of his early life beyond the fact that he was educated at a private school at Reading. He died at his home in London on Easter Monday, March 28, after a short illness which terminated a long period of failing health.

The earliest contributions made by Mr South to the entomological journals, in 1874-78, concerned his captures in the Mill Hill district, Hendon, which appears at that time to have been a very rich locality. Up to 1890 he contributed sixty notes and articles to the *Entomologist* and the *Entomologists' Monthly Magazine*, dealing with a great variety of subjects. The most important were his "Contributions to the History of the British Pterophori", published at intervals from 1881 until 1889, which added considerably to existing knowledge of the British plume-moths. He early developed a particular liking for the Microlepidoptera, and many of his notes concern this large group, especially the Tortricidae, others are faunistic, for example, "The Lepidoptera of the Outer Hebrides, Shetland and Orkneys" (*Entom* pp 25, 28, 98, etc., 1888), some deal with migration, others with collecting results, variation, etc. His "Notes on the Genus *Lycæna*" (*Entom*, pp 1, 49, 73, 121, 1887), in which the variation of a number of species was described in detail, led him into an acrimonious discussion of the species-concept, upon which his views were somewhat unorthodox. This was not the only matter which brought him into conflict with other lepidopterists of this period, for a year or two earlier, in 1884, in co-operation with those responsible for the *Entomologist*, he produced a "Synonymic List of the British Lepidoptera". This was designed to act as a label and exchange list and to replace Stainton's, which was long out of date but still the only one available. In the nomenclature used he did his best to apply the law of priority, which necessitated changing a very large number indeed of the names commonly employed—to the very great annoyance of every working lepidopterist of the day. Nevertheless, the list is in constant use even now.

About this time Mr South's interest in the Microlepidoptera appears to have brought him into touch with John Henry Leech, to whose "British Pyralidae" (1886) he contributed a number of notes. The association developed, only to be broken by the death of Leech in 1900. During this period he acted as a kind of curator and adviser to Leech, whose interest in the Far East eventually led to the publication of the "Butterflies of China, Japan and Korea" (1882-1894), in the production of which all the spade work was done by South. This was supplemented by the publication elsewhere of the descriptions of a very large number of eastern Heterocera new to

science. In order to acquire an outlet for this work, Leech purchased the *Entomologist* in 1890 and appointed South to the editorship, which he retained until 1924. For many years after Leech's death, South continued to work at the Far Eastern fauna, chiefly in collaboration with Wileman, jointly with whom he published a number of papers.

In 1906 there appeared South's "British Butterflies", the first of the three handy little volumes of the Wayside and Woodland Series, which are now standard works on our British Lepidoptera, and have made his name familiar to amateur and professional alike. The volumes on the moths appeared in the following years (1907 and 1908). Although the appeal of these volumes was directed to the beginner, both text and illustrations were so excellent that they at once achieved an immense and deserved popularity, which is not likely to desert them for many years to come. Undoubtedly it is by these volumes and by his long and successful editorship of the *Entomologist* that Mr South's name will be remembered amongst British lepidopterists long after those of us who had the pleasure of knowing him as a charming and courtly gentleman, an enthusiastic and painstaking entomologist, an excellent companion, and an honoured personal friend, have passed over where he has so lately gone.

MR ST GEORGE LANE FOX PITT

By the recent death of Mr St George Lane Fox Pitt at his residence in South Eaton Place, at the age of seventy-five years, we lose one of the few remaining pioneers of electric lighting. He was the second son of Lieut-General A H Lane Fox Pitt-Rivers, a distinguished anthropologist and archaeologist, who presented his collections to the University of Oxford. In his early days, Lane Fox Pitt (his father took the surnames of Pitt-Rivers for himself and that of Pitt for his family) devoted himself to scientific research and mechanical invention. In 1878 he took out a patent for the method of running incandescent lamps in parallel. This patent, being one of the earliest in electric lighting, has been often quoted in the law courts.

He also took a leading part in improving incandescent lamps. The early glow lamps had carbon filaments in a vacuum glass bulb. These filaments were connected with the mains by 'leading-in' wires passing through the glass. These leading-in wires were made of platinum, which has the same thermal coefficient of expansion as glass. Great difficulty was experienced in connecting the filaments and the platinum wires. The connexion was at first a simple mechanical one, the filaments being merely clamped to the wires. This joint, however, was not satisfactory, as it often worked loose. One of the earliest methods Lane Fox Pitt employed to get over this difficulty was to use a hollow carbon tube into which the platinum wire was inserted.

In 1883, Lane Fox Pitt took out an important patent for altering the pressure of electric supply by means of a motor dynamo. This was one of the earliest types of transformer. He was also one of the first to advocate a public supply of electricity from central stations.

Lane Fox Pitt was one of the early active workers in the Society for Psychical Research, and wrote several books on science, philosophy, education, and social problems. He contested three elections in the Liberal interest, but without success. He married, in 1899, Lady Edith Douglas, daughter of the eighth Marquess of Queensberry.

We regret to announce the following deaths

Prof W R Dron, Dixon professor of mining in the University of Glasgow since 1923, on April 16, aged sixty-three years.

Sir Patrick Geddes, formerly professor of socio-

logy and civics in the University of Bombay and of botany at University College, Dundee, who was well known for his work for education and the study of sociology, aged seventy-eight years.

Dr Alfred Hay, sometime professor of electro-technology, Royal Indian Engineering College, Coopers Hill, and afterwards at the Indian Institute of Science, Bangalore, on April 13, aged sixty-six years.

Prof G M Robertson, professor of psychiatry in the University of Edinburgh, and physician superintendent of the Royal Edinburgh Hospital for Mental and Nervous Disorders, on March 28, aged sixty-eight years.

Mr Eustace Short, of the firm of Short Brothers, of Rochester, who was a pioneer in the design and construction of aeroplanes, on April 8, aged sixty-two years.

Prof A L Urquhart, O B E, professor of pathology at the University of Cairo, on March 28.

## News and Views

### In Honour of Darwin

ON April 19, 1882, science sustained an irreparable loss by the death of Charles Darwin in his seventy-fourth year. On April 26 of that year his mortal remains were borne on the shoulders of his comrades to his last resting-place at Westminster Abbey, where they were laid close beside the graves of Sir John Herschel and Sir Isaac Newton. At the end of last year we commemorated the centenary of the start of Darwin's famous voyage in the *Beagle*, three years after his return he married, and in 1842 settled at Downe, Kent. It is no exaggeration to say that the work which emanated from that quiet English home during the succeeding forty years proved more effectual than any other in making the nineteenth century illustrious. The general facts upon which the principle of evolution by natural selection is based—the struggle for existence, survival of the fittest, and heredity—were all well known before Darwin's work. His claim to everlasting memory rests upon the many years of devoted labour whereby he tested the idea in all conceivable ways, amassing facts from every department of science, balancing evidence with the soundest judgment, and at last astonishing the world as with a revelation by publishing the completed theory of evolution by natural selection. Of very few men in the history of our race can it be said that they not only enlarged science but also changed it, not only added facts to the growing structure of new knowledge but also profoundly modified the basal conceptions upon which the whole structure rested and of no one can this be said more truly than of Charles Darwin. It is a striking tribute to his memory that April 19 was declared a public holiday in the U S S R in honour of the author of the "Origin of Species."

### Research Scholarships at the Royal College of Surgeons

At a meeting of the Council of the Royal College of Surgeons of England on April 14, the president of the

College, Lord Moynihan, announced an important benefaction from the trustees of the late Viscount Leverhulme. In presenting £1000 to provide "Leverhulme Scholarships" in surgical research, the trustees expressed the hope of being in a position to make a similar donation from year to year. The gift thus announced permits the Council of the College to go forward with an ambitious scheme of experimental research made possible by the munificence of Sir Buckston Browne, who a year ago gave £100,000 to build, equip, and endow a Research Farm at Downe, Kent. The Buckston Browne Research Farm, which is approaching completion, has been built on land which adjoins the home and grounds of Charles Darwin, which Sir Buckston acquired in 1928 and conveyed to the British Association, to be maintained as a memorial of Darwin and to be used for the advancement of science. The Leverhulme Scholarships are to be given to aid young men and women who are selected by the Council of the College to investigate surgical problems at the Buckston Browne Research Farm. Besides the laboratories at Downe, the Council has also equipped laboratories in the College, Lincoln's Inn Fields. These are now fully occupied. Lord Moynihan succeeded in obtaining temporary scholarships for men working in the College laboratories from Sir Bernhard Baron, Lord Beaverbrook, and the late Lord Melchett. The Council also sets aside annually from its own funds £500 to provide a College fellowship in surgical research.

### Australian Observatories

FOR reasons of economy, the Australian Premiers' Conference has decided that there shall in future be only two national observatories instead of the existing five (Perth, Adelaide, Melbourne, Sydney, and Canberra). The total saving cannot be great, since the combined revenues of all five from governmental sources amount to less than £15,000 per annum; nevertheless, three are to be closed. The Premiers' Conference has asked Sir Thomas Lyle, Dr A C D.



Rivett, and Prof O U Vonwiller to advise it as to (1) the locations of the two to be retained, (2) the disposal of existing equipment, and (3) the probable initial cost, if any, of supplementing existing equipment at the two chosen observatories, the estimated cost of maintenance of these two, and the best means of disposing of outstanding work in connexion with the Astrographic Catalogue, to which work several of the States were committed many years ago. Maybe two institutions, if thoroughly well supported, will be more effective than five inadequately maintained, but many will view with misgiving a decision of this kind based mainly on a desire to save money.

#### Early Man in East Africa

THE conclusions at which Dr Leakey, Dr H Reck, and Mr A T Hopwood arrived in their recent investigation of the Oldoway Beds in relation to the antiquity of the human skeleton found in these deposits would appear to have received confirmation by a find at Kanam, a small native village on Lake Victoria. Here Dr Leakey, it is reported in a dispatch from Nairobi which appeared in the *Times* of April 19, has discovered a lower jaw of *Homo sapiens* in deposits containing pre-Chellean implements and teeth of the same species of *Dermotherium* as was discovered at Oldoway. At Kanam, however, the beds in which the find was made correspond with the oldest of the Oldoway beds, whereas Oldoway man was found in Bed No 2. Other finds reported from early Pleistocene deposits at Kanam are fragments of three human skulls, apparently washed out from deposits containing Chellean tools and remains of *Elephas antiquus* and *Hipparion*. At first sight, this find on Lake Victoria carries *Homo sapiens* back a stage further than the Oldoway discovery, but a more detailed account of the deposits and the conditions of the find must be awaited before a certain conclusion is possible. The difficulty of accepting a skeleton found entire, as was Oldoway man, as contemporary with the alluvial deposits in which it occurs—a difficulty already pointed out (*NATURE*, Feb 27, p 312)—is stressed in the current number of *L'Anthropologie* (t 42, p 214), where it is also suggested that the general conformation of the Oldoway skull points to an affinity with the modern Masai.

#### Liquid Carbon Dioxide in Ocean Water

IN an interesting article (*C R Acad Sci Leningrad*, 1931), the eminent Russian geochemist, V Vernadsky, directs attention to the fact that the conditions of temperature and pressure in the depths of oceans should necessitate the existence there of carbon dioxide in a stable liquid state. The chemical interrelations of water and liquid carbon dioxide are as yet unknown, but they must play an important part in the life of organisms at great depths. Their gaseous metabolism should differ greatly from that of organisms inhabiting the surface layers of water, where the expired carbon dioxide can exist as a gas. It is known that the lower limit of plankton is about 200 metres from the surface, while sunrays penetrate very much deeper, and photo-synthesis is theoretically

possible for red algae down to 400-500 metres. They do not, however, occur below 200 metres, which means that the limit of their distribution is not governed by the lack of active light rays, but probably coincides with the zone where the gaseous state of carbon dioxide becomes unstable and the liquid state appears. Again, the conditions of gaseous metabolism of numerous organisms in the mud at the bottom of the oceans should be highly peculiar, the gases present there constituting an atmosphere very different from that in the mud of shallow waters. The interesting fact discovered more than a hundred years ago by Biot that the bladder of deep-sea fishes contains pure oxygen, which, according to later discoveries, is produced by special glands, has always remained a physiological puzzle, but it is possible that this is also connected with their life in the zone where only liquid carbon dioxide exists. It is legitimate to ask, for example, whether the oxygen in the bladder is not the result of decomposition of liquid carbon dioxide. All these considerations and examples serve to stress the necessity of organising systematic investigations on the distribution of gaseous and liquid carbon dioxide in different zones of oceans.

#### The Willis Navigating Machine

AT a recent meeting of the Royal Astronomical Society, the capabilities of this ingenious instrument (aviation type), designed by Mr E Willis for the solution of spherical triangles, were demonstrated by Dr L J Comrie, Superintendent, H M Nautical Almanac Office. Mechanically, the instrument is a combination of an alt-azimuth and equatorial with five graduated circles corresponding to altitude, azimuth, latitude, declination, and hour angle. The principal problem in nautical astronomy is the calculation of the altitude and azimuth of a heavenly body from given values of the latitude, declination, and hour angle. These quantities are set on the corresponding circles and the machine at once gives the appropriate altitude and azimuth, which can then be used, in conjunction with the altitude from a sextant observation, to give the position line on the chart. This is only one of the many problems that the instrument can solve. In the type of instrument designed for aeronautical navigation, the circles read to five minutes of arc, which is sufficiently accurate in practice, being of the same order of accuracy as readings made with a bubble-sextant. The instrument designed for marine purposes is larger and more accurate, in this type the graduated circles read to one minute of arc. In aeronautical navigation, the quick reduction of observations is an essential desideratum, and the Willis machine gives complete satisfaction in this respect. The instruments are manufactured by Messrs Heath and Co, New Eltham, London, S E 9.

#### Insulators for Switchgear and Busbars

AT present there is a great demand for insulators for high voltage outdoor isolating switchgear. With a pressure of 132,000 volts and a high mechanical stress, the greatest care has to be used in their design, as any breakdown in the continuity of supply of a

large amount of electric power may disorganise many factories. In the usual design of high pressure insulators, cement is used inside the porcelain to join the shells and the metal parts together. Any expansion of the cement imposes bursting stresses on the porcelain, which often cracks. Some manufacturers, with this danger in view, sacrifice some of the mechanical strength of the joint by inserting elastic layers of bitumastic paint and, in addition, dilute the cement with sand to reduce the percentage expansion. Continental engineers have recently been using insulators in which internal cement layers have been entirely eliminated. They consist of porcelain cylinders carrying suitable projections called rain-sheds and containing no cement layers. The elasticity of the flanges takes up the expansion of the cement. This cylindrical construction has been developed in Great Britain by Messrs Steatite and Porcelain Products, Ltd, who export them abroad. They now supply 132 kv cylindrical type switchgear insulators for the substations of the latest section of the British grid. The disadvantage of the wide base customary with this type of insulator has been overcome by the introduction of an ingenious series of flanged castings, so made that all the standard methods of fixing now in use can be applied to the cylindrical insulators. They are so designed that the greatest possible amount of surface is exposed to natural cleaning. The use of these new insulators on the grid will, during the next few years, give an opportunity of comparing them with the older type under working conditions. Their increasing use on lower voltages should help towards the electrician's ideal of complete continuity of service.

#### Boiler Plant in Power Stations

To the electrical engineer a knowledge of the thermal efficiency, operating costs, and trustworthiness of the boiler plant in his power station is almost as important as a knowledge of his electrical machines. J. Bruce read a lengthy paper on this subject on March 10 to the Institution of Electrical Engineers. He had, however, to omit the discussion of flue gas, dust, and sulphurous fume extraction, as the Chimney Emissions Committee has not yet reported. He pointed out that a study of present-day American conditions leads to the general conclusion that the best American generating stations have a higher thermal efficiency than those representative of the best average British practice. A number of American generating stations produce a kilowatt hour for a heat expenditure of less than 14,000 B.Th.U. This is due to better boiler plant and to the higher grade of employee used in operating it. The Detroit Edison Company, for example, has a boiler-house efficiency of 87 per cent. In the United States, when a station uses high steam pressure, it either uses a pressure of about 600 lb per square inch or one of about 1300 lb per square inch. At the present time, there are 15 boiler units operating successfully and with no serious troubles in the neighbourhood of the higher pressure. Large boiler units capable of evaporating one million pounds of water per hour are being successfully

operated. The capital cost of the boiler plant required increases rapidly with the pressure when it is above 600 lb per square inch. Consequently, when coal is cheap the interest on the increased capital cost may more than offset the gain in the heat efficiency. America has the advantage over Great Britain that combustion equipment can be developed for a particular quality of coal owing to the geological characteristics of the coal being uniform over wide areas. British practice, although not obtaining such excellent thermal results, has yet made good progress of recent years.

#### Manufacture of Electric Lamps

ONE of the exhibits at the Faraday Centenary Exhibition last September which attracted much attention was that showing some of the operations in the manufacture of electric lamps. Only a few of the operations could be demonstrated, but much further information on the subject is contained in an article on "The Mass Production of Electric Incandescent Lamps" in *Engineering* for March 25. The article contains a description of the new Wembley Lamp Factory of the General Electric Co., Ltd, which has a capacity of 25,000,000 lamps a year. All the machines used are illustrated, and many interesting facts are given about the manufacture of the components of a lamp. The tungsten for the filament is obtained from the ore scheelite. It is first prepared in the form of powder, which is subjected to very great pressure and then treated in an atmosphere of hydrogen, first at about 1200° C, and then at about 3000° C. Sixty drawings are required to reduce the original 1 mm rod to a filament 0.015 mm in diameter, and a tungsten bar  $\frac{1}{4}$  in square and 10 in long can be drawn into 15 miles of filament. The leading-in wires, which used to be of platinum, are now of copper-covered nickel-steel. The important operation of exhausting the lamps and then filling them with gas is done on capstan machines, each holding twenty-four lamps. Vacuum pumps reduce the pressure in them to a few thousandths of a millimetre of mercury, heat from an oven drives off moisture and adsorbed gas, and, while still hot, the lamps are filled with a mixture of nitrogen and argon, the internal pressure when cold being about two-thirds of an atmosphere.

#### The World's Natural History Societies

THE diffusion of scientific interests in the world, as indicated by the numbers and distribution of natural history societies, has been studied by Enrique Sparrn (*Bol. Acad. Nac. Cienc. Buenos Aires*, vol. 31, p. 171, 1931). Confining the inquiry to the larger societies, with a membership of 500 or more, the author finds that the world total amounts to 116 societies, of which 52 are devoted to natural history in general, 34 to zoology, 14 to botany, and 16 to geology. From a geographical point of view, natural history interests would appear to be tolerably restricted, for when we have mentioned 83 European societies with a total membership of 132,182 individuals, and 30 American societies with a membership of 160,947, there remain only 2 societies in Asia with a membership of 1938,

and one in Australia with a membership of 550. In this short note it is impossible to analyse all the naturalist sciences, but since zoology is by far the most populous, it may be taken as illustrating the general trend. Of the 34 great zoological societies in the world, 13 concern themselves with zoology in general (40,178 members), the others are specialist: 10 societies of entomology, with 10,165 members, 7 of ornithology, 10,672, 2 of mammalogy, 1775, one of ichthyology, 650, and one of ecology, 600.

THE distribution of the zoological societies gives a glimpse of the Nature-loving character of nations. The United States possesses 12 zoological societies (15,299), Great Britain 7 (19,163), Germany 5 (6110), Holland 2 (7640), France 2 (2400), one each in Belgium, Canada, Hungary, Austria, Australia, and Japan, with membership varying from 10,415 in Belgium to 538 in Japan. The Belgian Société royale de Zoologie d'Anvers is the largest of zoological societies, its 10,415 members indicating perhaps the standard of the simple acquirements which admission demands, next on the list in magnitude are two well-known British institutions—the Zoological Society of London (8200) and the Royal Society for the Protection of Birds (4500). It is curious that zoological societies as things apart did not come into existence until the second quarter of the nineteenth century. Zoological Society of London, 1826, Royal Zoological Society of Ireland, 1832, Entomological Society of France, 1832, Entomological Society of London, 1833, Zoological Society of Amsterdam, 1838, and so on. Four societies of general natural science hail from the eighteenth century—the Society of Natural Sciences of Danzig, 1743, the Society of Natural Sciences of Zurich, 1746, the Linnean Society of London, 1785, and the Society of Natural History of Hanover, 1797. In all, it would appear that at least 295,617 individuals in the world have an interest, more than fleeting, in the natural sciences.

#### Leonhard Stejneger, Antiquarian and Naturalist

It is fitting that the autumn number (No 3, 1931) of *Copeia*, a journal of cold-blooded vertebrates published by the American Society of Ichthyologists and Herpetologists, should have appeared as a special tribute to Leonhard Stejneger and his work. For Stejneger is to American cold-blooded vertebrates what G. A. Boulenger is on this side of the Atlantic. Endowed with great personal charm and a willingness to share his profound knowledge, to which the writer of this note has more than once been indebted, Stejneger is a man in whom great diversity of interests and talents has been combined. As Thomas Barbour in a tribute to his friend says, "Being an antiquarian, a classicist, a rarely accomplished linguist, and a naturalist in the widest sense, he possessed a foundation on which with good health and great industry he has built a mighty structure of rarely excellent work." The anniversary number, with its many papers on reptiles, amphibians, and fishes, is a fitting monument to this native of Bergen and graduate of the University of Christiania, who since 1882 has been

associated with the Smithsonian Institution and since 1911 has been its head curator of biology.

#### Reindeer Ranching in Northern Canada

DOMESTIC reindeer were introduced into Alaska from Siberia at the end of the last century and have done so well there, according to Mr. M. A. Earle Kelly in an article in the *National Review* for February (p. 215), that the reindeer ranching industry in Alaska is expected to become more important than mining. Now, he says, the three-year trek of Canada's first herd, of 3000, is nearly at an end, as they will shortly arrive at the Mackenzie delta, there to furnish stock to be established across northern Canada in the interest of the Eskimo, hard-pressed by contact with civilisation, which has destroyed or driven away the animals on which he lived. It is hoped that he will become a reindeer rancher, and four families of the Lapps, so well known in this capacity, have already reached Kittigazuit in the Mackenzie estuary, in company with Mr. A. E. Forsild, who, with his brother, has been arranging for the purchase and transport of the herd for the Canadian Government. Reindeer have done so exceedingly well in Alaska, which is now even supplying their meat for American markets, that there should be no obstacle to similar success in the contiguous Canadian tundra, which, it is estimated, could carry 12,000,000 of them, where ordinary domestic ungulates could not live.

#### The Cigarette Habit

At a meeting of the Society for the Study of Intemperance and Drug Addiction on April 12, a paper on the cigarette habit was read by Dr. J. D. Rolleston, who dealt with its history, economics, pharmacology, and clinical aspects. Cigarette smoking appears to have originated in South America, where it was reported by travellers and missionaries in the eighteenth century, and thence to have been introduced to Spain, where it was described by Casanova in a visit to Madrid in 1767. The cigarette was afterwards introduced into France and Italy, but it was not until after the Crimean war (1856), when French and English officers acquired it from their Turkish allies, that the cigarette habit became diffused over Europe. Germany, where the cigar was more popular, was among the last European countries to adopt the cigarette, it did not become firmly established in England until the 'eighties. There has been a great increase of cigarette smoking since the War, especially among women, in all European countries and the United States. Dr. Rolleston pointed out that the cigarette differs from other preparations of tobacco in its nicotine content being lower than that of the cigar or pipe, whereas the amount of carbon monoxide in cigarette smoke is comparatively high. Furfural, which is usually absent in the smoke of the pipe and cigar and present in only very small amounts in that of the Turkish cigarette, is found in comparatively large quantities in the smoke of the cheaper kinds of Virginia cigarettes and is liable to give rise to symptoms of intoxication. Medical opinion is still divided as to the part played by tobacco in general and the cigarette in particular in the causation of

certain diseases, such as angina pectoris and cancer in various situations, and the risk of laryngeal involvement in smoking by tuberculous patients. General unanimity, however, seems to prevail as to the injurious effects of smoking by the young or by the subjects of cardiac neurosis or peptic ulcer.

#### Food Preservation by Refrigeration

THE publication, by the Australian Council for Scientific and Industrial Research, of a survey and scheme for research in refrigeration as applied to the preservation and transport of foodstuffs is a matter of importance at a time when attention is being focused on means of improving and extending export trade. The report has been prepared by Dr J R Vickery, who is in charge of the newly created Section of Food Preservation. Information is particularly required as to the possibility of exporting beef in a chilled rather than frozen condition, and since there appears a considerable outlet in Great Britain for Australian bacon pigs, and good ham and bacon can be manufactured from frozen carcasses, investigations are needed to determine the best methods of freezing, storing, and thawing them so that the curing process may be most successfully carried out. Fruit, particularly apples and pears, forms another large branch of Australia's export trade, but much loss is sustained annually through wastage during transport. Besides the need for more definite information as to the best type of storage conditions, knowledge is lacking as to where temperature and humidity are particularly important, and how far pre-picking factors such as orchard conditions and degree of maturity of the fruit, etc., may affect its subsequent storage life. The report concludes with recommendations for the establishment of two laboratories with attached cold storage facilities, at Brisbane and Melbourne, the former to study problems in meat export trade and in the transport of tropical fruits, and the latter to investigate the preservation and transport of non-tropical fruits.

#### Estimation of Food in a Bird's Stomach

THREE methods have been employed in estimating the quantity of food in a bird's stomach, in order to discover whether a bird is beneficial or harmful: the materials found may be weighed, they may be measured by volume, they may be counted. The weighing method is not practicable, because quantities are sometimes exceedingly small, and besides, relative weights of vegetable and insect matter convey no real information about the economic status of the bird. The second method, of estimating by volume beneficial insects and injurious insects, useful vegetation and useless vegetation, has been almost universally adopted, following the practice of the experts in the Bureau of the Biological Survey of the United States Department of Agriculture. A reaction from this method is noticeable in a monograph on the food-habits of the Californian brewer and red-winged blackbirds by Pablo S Soriano (*Califorma Fish and Game*, 1931, p 361). Here percentage by volume has been used only in estimating the space occupied by vege-

table food or animal food or pebbles in the stomach, since the presence of one limits the presence of the others. But, since the degree of injury or benefit that an animal does depends directly upon the total number of injurious organisms that it destroys, the numerical method, of actually counting the specimens, has been followed in taking the percentage of the different kinds of foods. So an old method, once universally used, but ousted by the volumetric method, returns to favour again.

#### Advancement of Science in Australasia

THE twenty-first meeting of the Australian and New Zealand Association for the Advancement of Science is to be held in Sydney, during the week commencing Aug 17. The president is Mr E C Andrews, Government Geologist, Sydney, and the president-elect Sir Hubert Murray, Lieutenant-Governor of Papua. According to the preliminary programme, the following presidents of sections have been appointed: Section A (Astronomy, Mathematics, and Physics), Prof C E Weatherburn, University, Perth; Section B (Chemistry), Prof L S Bagster, University, Brisbane; Section C (Geology), Prof H St J Summers, University, Melbourne; Section D (Zoology), Prof G E Nicholls, University, Perth; Section F (Anthropology), Mr E W P Chinnery, Government Anthropologist, Rabaul, Mandated Territory of New Guinea; Section G (Economics, Statistics, and Social Science), Mr E C Dyason, 92 Queen Street, Melbourne; Section H (Engineering and Architecture), Mr J R Kemp, Main Roads Commission, Brisbane; Section I (Medical Science and National Health), Dr R W Cilento, Director of Tropical Hygiene, Brisbane; Section K (Agriculture and Forestry), Prof J W Paterson, University, Perth; Section L (Veterinary Science), Dr W A Robertson, Director of the Division of Veterinary Hygiene, Department of Health, Canberra, F C T; Section M (Botany), Dr R S Rogers, 118 Hutt Street, Adelaide; Section N (Physiology and Experimental Biology), Dr C H Kellaway, Director of the Walter and Eliza Hall Institute, Melbourne Hospital, Melbourne; Section P (Geography and Oceanography), Dr P Marshall, Department of Scientific and Industrial Research, Wellington, New Zealand. The honorary general secretary of the Association is Dr A B Walkom, Science House, Sydney.

#### X-Ray Crystal Analysis and its Applications

THE discourse to be given by Sir William Bragg at the Royal Institution Conversazione on Friday evening, May 6, will be related to the various developments in pure and applied science which have depended on the use of the X-ray methods of analysing crystal structure. In order to supplement the discourse, which cannot refer to more than a few of the more important points, an exhibition is being arranged in the rooms of the Royal Institution which will demonstrate more fully the work that has been done. The contributors will be those who have carried on research work in this subject in various British labora-

tories, so that the result should be interesting and, so far as space allows, comprehensive. Members of scientific societies or senior students of universities and technical institutions, and others interested in this work, are invited to view the exhibits at the Royal Institution, 21 Albemarle Street, London, W 1, between 10 A M and 6 P M on Monday, May 9, or Tuesday, May 10. The Managers of the Royal Institution would be glad if such visitors would leave their names and addresses.

#### Announcements

LORD RUTHERFORD will open a discussion on "The Structure of Atomic Nuclei" at the Royal Society on April 28, at 4 30 P M. It is hoped that the following will take part: Dr J Chadwick, Dr C D Ellis, Prof R H Fowler, Prof J C McLennan, Prof F A Lindemann, and Mr N F Mott.

THE first Royal Society conversazione this year will be held in the rooms of the Society, Burlington House, on Wednesday, May 11.

At the meeting of the London Mathematical Society on Thursday, May 19, at 5 P M, at Burlington House, Prof H Levy will deliver a lecture on "A Numerical Study of Differential Equations". Members of other scientific societies who are interested are invited to attend.

SCIENCE Service announces that Dr Oscar Rice, of Harvard University, has been awarded the Langmuir prize of one thousand dollars of the American Chemical Society for work on the application of modern theories of physics to chemical problems, including the application of quantum mechanics to reactions between gases, and of modern theories of statistics to the study of metals and electro-capillarity. The award is given to a chemist in North America, man or woman, less than thirty years of age, in recognition of outstanding research in pure chemistry.

HIS MAJESTY THE KING has approved the award of the Royal Medals for 1932 of the Royal Geographical Society as follows: *Founder's Medal* to Mr H G Watkins, for his work in the arctic regions, especially as leader of the British Arctic Air Route Expedition; *Patron's Medal* to H R H the Duke of Spoleto, for his work in the Himalaya as leader of the Karakoram Expedition of 1929. The Council of the Society has made the following awards: *Victoria Medal* to Prof A P Coleman, of Toronto, for his contributions to the geography and geology of Canada; *Murchison Grant* to Dr K S Sandford, secretary of the Commission of the International Geographical Union on Pliocene and Pleistocene Terraces, for his personal work in that investigation during the past six years; *Back Grant* to Mr Hugh Clutterbuck, for his expedition to Akpatok Island; *Cuthbert Peek Grant* to Miss Gertrude Caton-Thompson, for her investigations in the historical geography of Lake Moeris; *Gill Memorial* to Dr E B Worthington, for his studies of East African Lakes.

A PRELIMINARY programme has been issued of the forty-third Congress of the Royal Sanitary Institute,

to be held at Brighton on July 9-16, under the presidency of Lord Leconfield. Among the subjects to be discussed are: prevention of measles mortality, vaccination, birth control, food and nutrition, illumination in industry, mental hygiene, aerobic and anaerobic organisms in sewage treatment, and teaching of hygiene and mothercraft in schools. Prof C E A Winslow, professor of public health at Yale University, will deliver the lecture to the Congress, and he will take as his subject "Current Tendencies in American Public Health". A Health Exhibition has been arranged in connexion with the Congress in the Dome and Corn Exchange. The Town Clerk and the Medical Officer of Health of Brighton are acting as the honorary local secretaries.

In connexion with the tours in the U S S R referred to in NATURE of April 2, p 503, it has been found that certain of them will clash with meetings of the British Medical Association and the International Physiological Congress at Rome. An additional tour has therefore been organised to leave London on June 18, returning about July 12. This party, however, can only be arranged if sufficient definite applications are received not later than May 20.

MESSRS Dulau and Co, Ltd, 32 Old Bond Street, W 1, have just issued a catalogue (No 198) of some 600 second-hand works at popular prices, dealing with the subjects of botany, entomology, ornithology, and general zoology.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A full-time woman assistant pathologist at the Elizabeth Garrett Anderson Hospital, Euston Road—The Secretary, Elizabeth Garrett Anderson Hospital, 144 Euston Road, N W 1 (April 28). A full-time lecturer in mechanical engineering at the Heanor Mining and Technical Institute—The Director of Education, County Education Office, St Mary's Gate, Derby (April 30). Two Imperial Chemical Industries' scholars at the Constantine Technical College, Middlesbrough—The Director of Education, Education Offices, Middlesbrough (April 30). A lecturer in geography at University College, Rangoon—The Secretary, Universities Bureau of the British Empire, 88A Gower Street, W C 1 (April 30). An assistant lecturer in agricultural economics in the University of Leeds—The Registrar, University, Leeds (May 2). An assistant lecturer in chemistry (with subsidiary botany, or pharmacognosy, or pharmacy) at the Belfast Municipal College of Technology—The Principal, Municipal College of Technology, Belfast (May 3). An assistant lecturer in chemistry at the Liverpool Central Municipal Technical School—The Director of Education, Education Offices, 14 Sir Thomas Street, Liverpool (May 6). A woman principal of the Bingley Training College for Women—The Education Officer, County Hall, Wakefield, Yorks (May 9). A woman principal of the Municipal Training College for Women Teachers, Portsmouth—The Secretary for Higher Education, Municipal College, Portsmouth.

### Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

#### Light and Diet as Factors in Relation to Sexual Periodicity

IN his recent communication regarding light as a factor in causing sexual periodicity in birds and mammals, Dr F H A Marshall<sup>1</sup> has directed attention to several examples of the induction of sexual activity in birds by prolonged daily light periods, and to the great rarity of animals not exposed to light variations at some time. Even nocturnal animals are subject to twilight. Not all have the same degree of susceptibility to light in this respect. He also cited conditions in tropical regions, such as the Cameroons, "where environmental conditions are similar throughout the year" and "native birds have no restricted breeding season but breed at any time."

That this is true only in a very broad sense was shown by Bates,<sup>2</sup> who found that some native birds breed there at any time, others only in the dry seasons, twice a year (in May, June, and July, and in November, December, and January), others only through half the year. Sex glands of both sexes often remain in breeding condition and size throughout the year. This suggests that breeding may be controlled by some factor other than light periods in some or all of these birds, even though comparatively long light periods may keep the sex glands actively producing germ cells.

Moreau<sup>3</sup> pointed out that, in any district, each species of bird has a rather restricted breeding season of about three months, relatively constant for any locality, but differing in neighbouring localities. He also pointed out that length of day is constant throughout the year only on the equator. It varies 40 min at 6° N or S, 70 min at 10°, and 3 hr at 23 5°. In this respect, therefore, the transition from equator to poles is gradual throughout, and differences are those of degree only. Light, in its relation to sexual periodism, is a world problem.

Moreau accepts Rowan's hypothesis<sup>4</sup> that longer periods of wakefulness or exercise induce sexual activity in many species in addition to juncos and crows, but finds it of doubtful value in the cases of long migrants, wintering beyond the equator, or on both sides of it. He is of the opinion that food is a controlling factor in breeding periodicity of tropical birds, the breeding seasons of which are seldom longer than three months. At Amari and Zanzibar, these seasons differ for species common to both districts. So the sexual activities of tropical birds are subject to seasonal cycles comparable with those of palæ-arctic birds. For him, this rules out photoperiodism for these birds, and makes climate and food supply more dominant factors in their sexual cycles. Lynes,<sup>5</sup> Vaughn,<sup>6</sup> Paget-Wilkes,<sup>7</sup> and others agree, and even suggest that rains and bush fires are related to the breeding cycles in Nyasaland.

Recent work by Bissonnette,<sup>8</sup> and Bissonnette and Wadlund,<sup>9</sup> on the modification of the sexual cycle of starlings in America, shows that testis activity is conditioned by daily period, intensity, and wave-length of light. The long wave red rays stimulate, and the shorter wave green rays inhibit germ cell activity. But, no matter how stimulating the light ration used, sexual regression sets in after a variable period of complete sperm formation. This period is

shorter in animals brought to the climax quickly, and longer in those activated more slowly. An optimum wave-length, somewhere in the red, and an optimum intensity of light, below 1856 foot candles of white light and nearer 29 foot candles intensity, are indicated. These results with starlings were obtained when birds were fed on a varied diet, rich in proteins, fats, and vitamins.

On the other hand, some unreported recent studies with starlings in Cambridge, using red light of a potency capable of inducing complete sperm formation in about twenty days on the rich diet used previously, indicate that, on a diet restricted to 'middlings' gram mash, the very stimulating red light is prevented from inducing testis activity, even in 22 days. This shows that, even when the daily light ration is adequate to induce sexual activity, the type of food may be a limiting factor and, under such conditions, control the appearance of seasonal activity. This may be the case with tropical birds, as described by Bates, Moreau, and others, and may account for the apparent correlation of diet with reproductive periodicity. Then, too, light intensity varies as between rainy and dry seasons.

Variations of susceptibility, of members of the same or of different species, to changes in light rations, would cause breeding activity to occur at somewhat different dates, even in the same locality, whether species are permanent residents or migrants.

In studies of mammals in this relation, by Bissonnette,<sup>10</sup> Baker and Ranson,<sup>11</sup> Marrian and Parkes,<sup>12</sup> and Moore and Samuels,<sup>13</sup> light ration and food have been found to influence reproductive activity. When either one of these two factors remains constant and adequate for activity, the resulting activity may be varied by changes in the other factor.

It becomes more evident that, while light ration plays a great part in conditioning the periodicity of sexual cycles in many birds and mammals, it is not the only factor operating. Seasonal changes in type or quantity of food must be reckoned with, in analysing the factors effective in any particular case.

We are still far from a general law in this connexion. But all will agree with Dr Marshall in maintaining the wide application of this principle of photoperiodism in sexual cycles.

T H BISSONNETTE

School of Agriculture,  
Cambridge, March 30.

<sup>1</sup> Marshall, F H A, *NATURE*, 129, 344, March 5, 1932.

<sup>2</sup> Bates, G L, *Ibis* (9), 2, 8, 558-570, 1908.

<sup>3</sup> Moreau, E R, *Ibis* (13), 1, 553-570, 1931.

<sup>4</sup> Rowan, Wm, *Proc Boston Soc Nat Hist*, 39, 152-208, 1929.

<sup>5</sup> Lynes, H, *Ibis*, 1, 757-797, 1925.

<sup>6</sup> Vaughn, J H, *Ibis*, 577-608, 1929, and 1-48, 1930.

<sup>7</sup> Paget-Wilkes, A H, *Ibis*, 690-748, 1928, and 475-490, 1931.

<sup>8</sup> Bissonnette, T H, *Am Jour Anat*, 45, 289-305, 1930. *Jour Exptl Zool*, 58, 281-319, 1931. *a Physiol Zool*, 4, 542-574, 1931. *b Science*, 74, 18-19, 1932. *a Physiol Zool*, 5, 32-123, 1932. *b*

<sup>9</sup> Bissonnette, T H, and A P R Wadlund, *Jour Morph*, 52, 403-428, 1931.

<sup>10</sup> Bissonnette, T H, in press.

<sup>11</sup> Baker, J R, and R M Ranson, in press.

<sup>12</sup> Marrian, G F, and A S Parkes, *Proc Roy Soc B*, 105, 248-252, 1929.

<sup>13</sup> Moore, C R, and L T Samuels, *Am Jour Physiol*, 96, 278-288, 1931.

#### Albertus Magnus as Chemist

THE article by Dr Greenwood<sup>1</sup> seems to me to lay too little stress on the point that while Albertus Magnus certainly advanced botanical and zoological science by much valuable original observation, yet in the realm of chemistry he contented himself with repetition and interpretation of earlier writings. The opposite impression given by the article seems to be due to the fact that Dr Greenwood regards "De Alchimia" as authentic. This book is, of course,



included in Jammy's collected edition of Albertus's works (an edition which is unfortunately not critical and often scientifically incomprehensible by reason of numerous textual mistakes), and in the still worse reprint of this edition by Borgnet. However, all Albertus's critics, from his first biographer, Petrus de Prussia, to Quétif, Sighart, and de Loe, down to Pangerl, have all definitely stated that he is not the author of this work, which completely cuts out all that has been repeatedly said about Albertus's personal experimental work.

In the genuine "De Mineralibus" Albertus does indeed refer to the composition of metals and to alchemistic questions, but only from a literary point of view, closely following Arabian writers, and he mentions occasional observations but never any personal tests really worthy of the name of chemical experiments. The phrase from "De Mineralibus", quoted by Dr Greenwood, "I have tested alchemistic gold", is not quite exactly translated thus, in the original it runs "*experiri feci, quod aurum alchimicum, quod ad me devenit, postquam 6 vel 7 ignes sustinuit, statim amplius ignitum consumitur et perditur, et ad faecem quasi revertitur*" (my italics). He himself had, therefore, not even made the very simple experiment of testing gold by fire, but had *had* it done.

That in the expression "*experiri feci*" the word "*experiri*" means "make an experiment", can be proved by Albertus's usual mode of speech. Compare, for example, the phrase "*Hi autem qui in cupro multum operantur in nostris partibus, Parisus videlicet et Coloniae et in aliis locis, in quibus fui et *vidi experiri*, convertunt cuprum in aurichalcum per pulverem lapidis qui calamina vocatur*" ("De Mineralibus", 11, 2, 6). Here there can be no doubt regarding the meaning of the word "*experiri*", so that the actual significance of "*experiri feci*" as "I have had experiments performed" becomes clear. When, on the other hand, Albertus has himself made experiments or observations he uses the normal "*expertus sum*", for example, "*Talpa . vermibus pascitur, et expertus sum quod libenter pascitur bufonibus et ranis*" ("De Animalibus", 22, 143). Therefore the phrase quoted by Dr Greenwood is in itself the best proof that Albertus was *not* an experimental chemist.

Perhaps it would not be superfluous here to add that in British and American literature about Albertus—for example, in the well-known works of L. Thorndike and E. J. Holmyard—"De Alchimia" is always referred to respectfully, obviously on account of its inclusion in the collected edition, in spite of its rejection by all competent scholars—though few go so far as Dr Greenwood, who does not even mention any doubt as to its authenticity. It should be specially emphasised here that the one feeble claim hitherto made for the genuineness of "De Alchimia" has recently been quashed. In one of the earliest inventories of Albertus's authentic works, the so-called "Stams Catalogue", a book "De Alchimia" is actually listed. It can now, however, be shown, in agreement with Petrus de Prussia and the conjectures of Pangerl, that the writing thereby meant was none other than a part of the book "De Mineralibus", which had originally appeared separately, this section is by chance still preserved in a collective manuscript, in the middle of medical writings, as an independent "*tractatus de metallis et alchimia*"<sup>2</sup> (It is known of several other of Albertus's writings that parts of them appear in other manuscripts as independent books under their own titles). Neither from its style nor contents can the much-later work "De Alchimia", included by Jammy and Borgnet in the collected edition, be ascribed to him, this was clearly recog-

nised and affirmed by Hermann Kopp, in his studies of the history of chemistry, as well as by all expert Albertus scholars. In consequence, therefore, of the spuriousness of this book "De Alchimia", much that Dr Greenwood quotes as Albertus's chemical knowledge must also be struck out, only the much smaller amount to be found in "De Mineralibus" can serve as a measure of it.

Albertus apparently never experimented chemically. As head of the German Dominican Order, having to inspect all its monasteries (then including those in Holland, Hungary, and Poland), and for a while as crusade-preacher, most of his life was spent in wandering on foot (according to the rules of his Order), he had therefore ample opportunities for making botanical and zoological observations, but not for chemical experiments. It is incompatible to think of this Nature-loving yet scholarly monk spending long attentive hours with crucible and furnace in a laboratory. Even the numerous thick quarto volumes (always quoted by his admirers as evidence of his scientific eminence, whereas their very prolixity—as now preserved, at least—actually diminishes their scientific value) could be cited as still further proof that all his spare time must have been very fully occupied in writing in his study, as his biographers tell us.

Besides the critically revised editions of Albertus's botanical and zoological works, which we owe to the labours of Ernst H. F. Meyer, O. Jessen, and H. Stadler, a further scholarly edition of "De Mineralibus" is much to be desired, free from the sense-destroying faults of the collected editions, which were edited by scientifically-illiterate people. The verdict upon Albertus would not, however, be thereby materially altered. In biological science he was an original worker of a high order, but, on the other hand, in chemistry a mere speculative philosopher, wholly dependent on the Arabs.

FRITZ PANETH.

Chemisches Institut der Universität,  
Königsberg i. Pr.,  
March 20

<sup>1</sup> NATURE, 129, 266, 1932

<sup>2</sup> See F. Paneth, *Archiv für Geschichte der Mathematik, der Naturwissenschaften und der Technik*, 12, 33 and 408, 1930

### Electrochemical Periodicities

In the course of experiments on the anodic polarisation of platinum electrodes in dilute sulphuric acid solutions saturated with hydrogen, we have observed, at small current densities, some striking periodicities

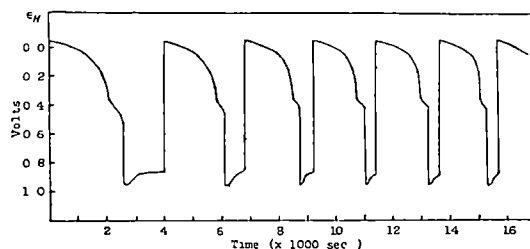


FIG 1—Change of potential with time,  $c = 50 \times 10^{-7}$

The change of potential difference with time in a typical experiment is shown in Fig 1. In this case the electrode potential falls continuously with a marked break at  $E_H = +0.4$  volt, to about  $+1.0$  volt, and then begins to rise slowly. At  $+0.9$  volt it suddenly jumps back to its initial value. This process appears to repeat itself indefinitely. In one experiment, with a current density of  $62 \times 10^{-7}$  amp/cm<sup>2</sup>,

we observed eighteen such periodicities in about 18,000 seconds, and the phenomenon showed no signs of coming to an end. With greater current densities the return to the initial value, which is near the reversible hydrogen potential, takes place at about +0.5 volt, and only a limited number of periodicities is observed. Fig. 2 (IV) is an example, obtained with a current density of  $150 \times 10^{-7}$  amp/cm<sup>2</sup>. The number of peaks is indefinite and varies from experiment to experiment. At high current densities no periodicities

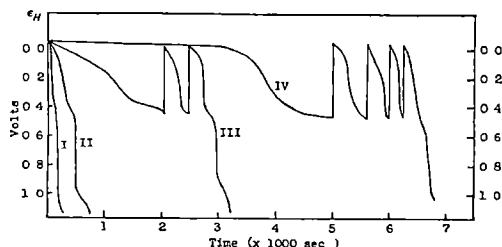


Fig. 2—Change of potential with time,  $c = 150 \times 10^{-7}$

are observed, but we have photographic records showing small peaks with a period of 0.2 sec using a current density of  $3500 \times 10^{-7}$  amp/cm<sup>2</sup>.

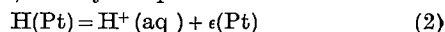
It is significant that these periodicities are never observed during the first anodic polarisation of the electrode. This is illustrated by curves I, II, and III (Fig. 2). After the first anodic polarisation (I) the current is stopped when the potential has reached about +1.2 volt, and the potential rises to its original value without the passage of any current. On subsequent anodic polarisations, curves II and III were obtained. In these experiments the electrode was given a constant amount of cathodic polarisation prior to each anodic polarisation. We found later that this was not essential, and that the condition necessary for the appearance of the periodicities could be produced by anodic polarisations alone.

In these experiments, potentials at which oxygen can be liberated are never reached, since the reversible oxygen potential is +1.2 volt and a considerable over-voltage is necessary even with a minute current density.<sup>1</sup> The transfer of electricity across the electrode boundary must therefore occur by some process other than the discharge of negative ions. The only substance which can give electrons to the electrode under these conditions thus appears to be hydrogen. The final stage ionisation potential of molecular hydrogen is about 15 volts, and, according to Dr R. W. Gurney's<sup>2</sup> application of quantum mechanics to electrolysis, it is not possible for hydrogen molecules in the solution to give electrons to the metal from a distance. It is thus probable that the electrons passing into the metal are derived from adsorbed hydrogen. It is suggested tentatively that the mechanism of the periodicities is as follows: at about +0.4 volt the first stage ionisation of adsorbed hydrogen molecules occurs, according to the equation



Since the dissociation energy of the  $\text{H}_2^+$  ion (in the gaseous state) is only 2.6 electron-volts and the hydration energy of  $\text{H}^+$  is of the order of 8 e-volts, it is probable that in contact with the solution  $\text{H}_2^+$  is unstable and dissociates, the hydrogen ion becoming

hydrated and the hydrogen atom passing into the electrode. There are now two processes whereby the transfer of electricity from the solution may occur, namely, by (1) and by the process



It is suggested that, for some reason which is at present obscure but may possibly be connected with the mechanism of diffusion of hydrogen atoms into platinum, the rate of process (2) may suddenly increase to a value greater than that necessary for the passage of the constant current. The potential difference will then rise, until the rate of (2) is adjusted to the current passing. The subsequent slow fall marks the gradual depletion of hydrogen in the metal. Ultimately potentials are reached at which process (1) occurs and the sequence begins again.

We are examining the phenomenon in detail in the light of this hypothesis, and we intend to find if similar effects can be obtained with other metals.

J. A. V. BUTLER.  
G. ARMSTRONG

King's Buildings,  
West Mains Road, Edinburgh,  
March 9

<sup>1</sup> Bowden, *Proc. Roy. Soc. A*, **126**, 107, 1929.

<sup>2</sup> *Proc. Roy. Soc. A*, **134**, 137, 1931.

#### Water-jet affected by Tobacco Smoke

A HOLLOW spindle-shaped water-jet (Fig. 1, A) may be produced by discharging the water through a cylindrical nozzle attached centrally to the bottom of a cylindrical vessel, in which the water is made to revolve by attaching a pair of inlet tubes tangentially to the top of the vessel. When a plate is placed horizontally at a proper distance below the nozzle and the rate of discharge suitably adjusted, a conical jet

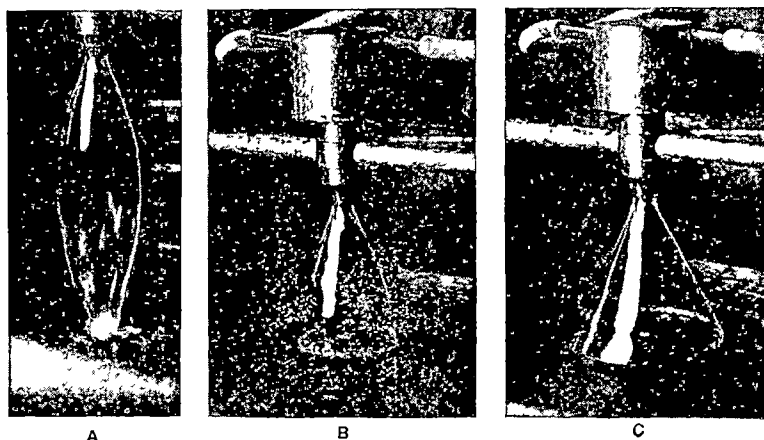


FIG. 1

(Fig. 1, B) is formed, which tends to contract in diameter, if left undisturbed. The contracting cone expands and resumes its original size if it is disturbed and broken by any obstacle. If, again, a thin glass tube be inserted through the skirt of the cone and air be blown into the cone, the jet-cone becomes expanded, especially near its lower margin, such that the jet assumes a form like a trumpet. If a puff of tobacco smoke is blown gently towards the jet, the cone, previously assuming a form as in Fig. 1, B, is expanded suddenly into the form as shown in Fig. 1, C.

The gradual contraction is due to the decrease of pressure in the inside of the cone. The effect of

smoke may be explained by the decrease of the surface tension of water

Detailed experiments were carried out by one of us (K Itô) regarding the effects of the rate of discharge, as well as the size and shape of the nozzle, upon the form of the jets, and the results will be published later in the Report of the Aeronautical Research Institute

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SIN TANAKA  
KYÔZI ITÔ

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### Upper Air Temperatures and Humidities in the Indian Peninsula

SINCE October 1928, more or less regular ascents of sounding balloons have been carried out from Poona and Hyderabad (Deccan) with meteorographs of the Dines type manufactured at the Upper Air Observatory, Agra. The ascents at Hyderabad were made from

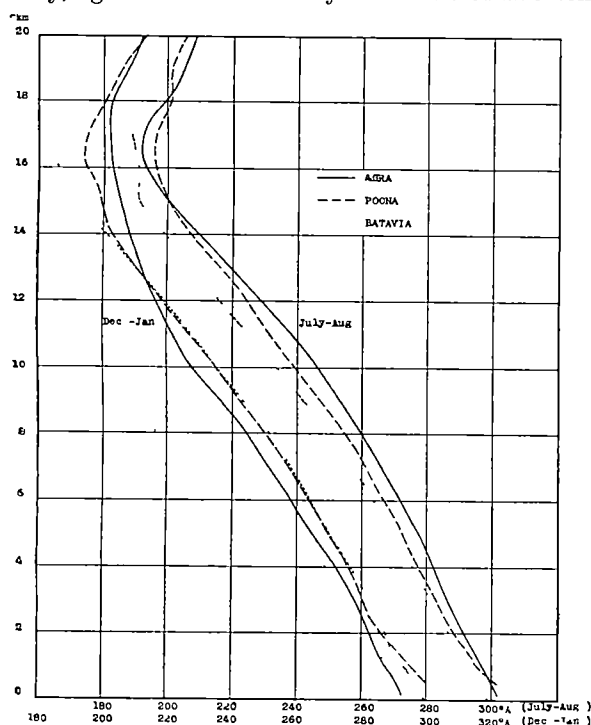


FIG. 1—Upper air temperature over Agra, Poona, and Batavia

the Nizamiah Observatory, Hyderabad, with the kind co-operation of its director. It may be of interest to summarise here some results of outstanding importance obtained as a result of these soundings

(1) During the monsoon months, July and August, the atmosphere over the Deccan is invariably colder than that over Agra in northern India, up to a level of about 14 geodynamic kilometres—the maximum mean difference of temperature being  $7^{\circ}\text{C}$  at a level of 10 gkm. Temperatures over Batavia in these months are lower still. The level of the tropopause in this season is about the same, or slightly lower, and its temperature higher in the Deccan than in northern India (Fig. 1). Considering the troposphere as a whole, the thermal equator over Indian longitudes lies over northern India at a latitude of about  $25^{\circ}\text{N}$ .

These results are specially interesting in view of the westerly to north-westerly movement of monsoon depressions. The normal upper winds are consistent with the temperature distribution

During the months July-September, the relative humidity in the air over the Deccan generally shows a maximum (saturation) between 1.5 gkm and 3.5 gkm, and is followed by a more or less rapid fall, extending over one or two kilometres, and at still higher levels by a rise. In about half the number of available records, the humidity falls off above 6-8 km, the fall being gradual. The decrease of humidity above the lower level of maximum humidity is sharper and larger during times of weak monsoon. It may be mentioned that the westerly winds of the monsoon give place to the easterlies of the inter-tropical circulation normally between 6 km and 8 km.

(2) Conditions are markedly in contrast in the winter. In the period November-February, temperatures over northern India are lower than those over Poona up to 13 gkm, and above that level higher. Between 4 gkm and 14 gkm, there is little difference between the temperatures over Batavia and Poona, but the tropopause is higher nearer the equator, and colder.

(3) The semi-permanent anticyclone in the upper air over the central parts of India during the months November-January shows itself in the temperatures over Poona as a well-marked region of small lapse-rate extending over 0.5-1 km, and starting at a level ranging from 2.5 km to 3.5 km. The trajectories of air movement in the upper air show that the air below the inversion usually comes from the Punjab and northern Rajputana through east Central India and the Central Provinces, while above the inversion, the air supply is from a direction varying from north to west, and has, in general, a higher velocity. The air below the inversion is surface-heated continental air from higher latitudes, and has a high lapse-rate. As may be expected, there is a maximum of humidity at the top of the lower convective layer.

K. R. RAMANATHAN  
K. P. RAMAKRISHNAN

Meteorological Office,  
Poona 5, Jan. 29

### Errors in Thermal Measurements

IN some recent investigations on adsorption<sup>1</sup> it seems to have been established that erroneous conclusions have been reached on account of errors unsuspected by the experimenters and arising from the time lag of thermometric apparatus. Workers with experience in thermal measurements are well aware of the possibility of such errors, and in particular the extreme care which must be exercised in the use of platinum resistance thermometers, more particularly when these are wound on insulating supports and enclosed in tubes. The application of such thermometers requires not only extreme care in avoiding thermometric forces in the circuit, but also in making certain that the very appreciable thermal lag is eliminated. Generally speaking, such thermometers are quite unsuitable for use when fairly rapid changes of temperature are involved, and in any case are best avoided, except by experienced workers. For practically all purposes, a properly chosen mercury thermometer is much more trustworthy.

Another source of error in such work, fully investigated by Prof. R. A. Millikan and by myself many years ago, is the impossibility of making any kind of cooling or heating corrections with time in the case of fine metal wire thermometers suspended in a gas in the proximity of large masses of metal or other conductors. The large interference in the temperature measurements with such apparatus, owing to radiation and conduction, cannot be eliminated by any method of extrapolation, even when a very rapid galvanometer,

such as a string galvanometer, is used. It has also been well established that the temperature coefficient of fine platinum wires is abnormal, and may vary appreciably during experiments if there is any possibility of movement of the wire, so that it is very unsafe to attempt to make temperature measurements by the use of any formula supposed to express the variation of resistance of the wire with temperature. Another apparently unsuspected source of error is involved in the use of a gas of good thermal conductivity, such as hydrogen or helium, in the calibration of apparatus in which heat transfer is involved, and the use of this apparatus for gases such as oxygen or nitrogen, the thermal conductivities of which are much less than that of the gas used in the calibration experiments.

Much greater confidence could be felt in results if experiments would bear these simple and well established facts in mind.

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East London College, University of London,  
London, E 1

<sup>1</sup> Garner and McKie, *Trans Faraday Soc*, **22**, 461, 1926. Bull. Hall, and Garner, *J Chem Soc*, 837, 1931. H S Taylor, Kistiakowsky, and Flodsdorf, *J Amer Chem Soc*, **49**, 2200, 1927. H S Taylor and Kistiakowsky, *Z physikal Chem*, **125**, 341, 1927. Schwab and Brennecke, *ibid*, **16 B**, 19, 1932.

### Hydrogen Peroxide and the Kolbe Reaction

A "RESEARCH Item" in NATURE of March 19 (p. 442) has directed our attention to a paper by Matsuda,<sup>1</sup> in which it is shown that hydrogen peroxide is formed in the course of the anodic oxidation of acetate solutions. The amount of peroxide obtained is correlated with the simultaneous production of ethane by the Kolbe reaction. As a result of a comprehensive study of electrolytic oxidation reactions, now in progress, we have independently arrived at the conclusion that hydrogen peroxide plays a very important rôle in certain anodic processes, although our point of view concerning the origin and influence of the peroxide is fundamentally different from that of Matsuda. It is hoped very shortly to publish the results of some of the experiments on which our views are based.

S GLASSTONE  
A HICKLING

Chemistry Department,  
The University, Sheffield,  
March 23

<sup>1</sup> *Bull Chem Soc Japan*, **7**, 18, 1932

### Constitution of the X-Chromosome in *Drosophila obscura*

THE recent discovery of *Px*, the allelomorph of the "Pointed" mutation in *Drosophila obscura*, m1, a sex-linked intensifier, and m2, an autosomal modifier, have enabled me to analyse the constitution and possible origin of the V-shaped X-chromosome in *Drosophila obscura*.

The great similarity in the morphological expression of Pointed in *D. obscura* and Beaded in *D. melanogaster*, and the similarity of their behaviour in the presence of modifying factors, proves their homology. The difference between the physiological effect of Pointed and Beaded, consisting in the fact that Beaded is lethal when homozygous and Pointed is not, is presumably due to their position in different genic systems.

The comparison of other corresponding genes in *D. obscura* and *D. melanogaster* such as yellow, white and eosin, shows that these genes do not exhibit their effects in the same degree in the two species, pre-

sumably because of the different genic systems in which they are placed.

If Pointed and Beaded are homologous, then we may explain their different position in the linkage groups by the translocation of the chromosome segment bearing the gene for these mutations. This assumption receives strong support from the comparative study of the chromosome complements in the related *Drosophila* species. The X-chromosome in *melanogaster*, *virilis*, and *simulans* is rod-shaped, in *obscura* and *willistoni* it is V-shaped and large as compared with the autosomes. Lancefield<sup>1</sup> (1922) and Metz<sup>2</sup> (1922) suggested that one arm of the V-shaped X-chromosome in these latter species corresponded to the rod-shaped X in *D. melanogaster*. If this is the case, it is reasonable to assume that the other arm of the V-shaped X-chromosome corresponds to a segment of one of the autosomes in the species with a rod-shaped X. This kind of condition would have been brought about by translocation, either of part of an original autosome to the X-chromosome or of a part of the X-chromosome with an autosome.

Comparative studies of the sex-linked mutations in these different species show that many identical genes, for example, the closely linked yellow-scute-white-Notch series, are transferred from the extreme left end of the X-chromosome in *D. melanogaster* to the middle region of the X-chromosome in *obscura* and *willistoni*. Recent investigations of the behaviour of Pointed and Pointed-x, located in the 'extra' arm of the V-shaped X-chromosome, indicate their homology with Beaded in the third autosome of *D. melanogaster*. It is therefore suggested that part of the X, namely, the segment to the left of the yellow locus in *D. obscura*, corresponds to part of the third chromosome of *D. melanogaster*.

Further evidence of such a chromosome rearrangement is given by the study of the hybrids of 'Race A' and 'Race B' in *D. obscura*.<sup>3</sup> (Lancefield 1930, Koller 1932) The hybrid females are partially fertile and exhibit great reduction in crossing-over at both ends of the X-chromosome, the males are sterile. I have shown<sup>3</sup> (1932) that only the ends of the X-chromosome differ in the two races (A and B) of *D. obscura*. This can be explained on the assumption that the translocated segment of the X's has a different origin in the two races, and that these non-homologous portions prevent the chromosomes from pairing and crossing-over.

These facts support the hypothesis regarding the constitution of the X-chromosome in *D. obscura*.

P CH KOLLER

John Innes Horticultural Institution,  
London, S W 19,  
March 10

<sup>1</sup> Lancefield, D E. Linkage relation of the sex-linked characters in *Drosophila obscura*. *Genetics*, **7**, 335-384, 1922. A genetic study of crosses of two races or physiological species of *Drosophila obscura*. *Z ind Abst Vererbung*, **52**, 2/3, 287-317, 1929.

<sup>2</sup> Lancefield, R., and Metz, Ch. The sex-linked group of mutant characters in *Drosophila willistoni*. *Amer Natur*, **56**, 211-241, 1922.

<sup>3</sup> Koller, P Ch. The relation of fertility factors to crossing over in the *Drosophila obscura* hybrid. *Z ind Abst Vererbung*, **60**, 2/3, 137-151, 1932.

### Mutation in Rice

THE incidence of mutation has not been infrequently reported in the common rice plant, *Oryza sativa* L. Most of the reported mutations in this crop plant are without any agronomic merit.

Matsuura,<sup>1</sup> in his monograph on plant genetics, mentions most of the mutations reported in rice. According to him, a case of dominant dwarf mutation originating from a common recessive rice was reported by Sugimoto (1923) Akemine (1925) and Nagai (1926).

mention cases of recessive dwarf mutations. Gene mutations resulting in various kinds of sterility have also been observed. Terao (1917, 1921), Kondo and Ono (1923), and Nagai (1926) record cases of complete or partial sterile mutants in rice. Terao (1922) mentions also a case of a 'large-grain' mutant from a common race of paddy.

During the rice season of 1931, I noted in the seedling stage after transplanting the appearance of three variant plants in a paddy culture of hybrid origin. These three plants were conspicuous by their short, compact, bushy growth and brevi-foliate appearance, while the remainder were tall with characteristic morphological features of an ordinary rice plant. Both the parents of the culture are normal tall plants with long leaves, and during the last eight years that the culture has gone through, no such off-type plants were ever observed.

These three plants, believed to have originated by mutation in the preceding generation, are characterised by shortened internodes, the culms ranging from 52 cm. to 60 cm. in height, in contrast to the average of 124 cm. of normal plants. The leaves are much reduced in length, but there is no corresponding reduction in breadth, as both the new type and normals show the same range. The spikelets showed normal development, and though anthesis occurred, the anthers completely failed to burst. As a result, the panicles were entirely sterile. This indicates that the mutated gene has also fatally affected the male gametes. One of the mutant plants was crossed with pollen from a normal plant from the same culture, and some seeds have been obtained. Apparently, the female gametes are functional. The inheritance of this abnormality is under investigation.

B S KADAM

Rice Breeding Station,  
Karjat, Kolaba, India,  
Jan 28

<sup>1</sup> Matsuura, H., "A Bibliographical Monograph on Plant Genetics (Genic-Analysis)", 1900-1925, pp xi+497 (Tokyo Imperial University, 1929).

#### Fatuoids or False Wild Oats

In a study of the segregates of a cross made between the tetraploid species *Avena barbata* and the diploid species *A. brevis*, certain points of interest have emerged concerning the behaviour of the characters which in the hexaploid species *Avena sativa* constitute the fatuoid complex. In the latter species, when a fatuoid is crossed with normal or cultivated type of grain the fatuoid complex behaves as a partial recessive and in inheritance gives simple Mendelian segregation, there is no break-up of the complex, and no crossing-over takes place. In the *Avena barbata*-*Avena brevis* cross, however, these same associated characters, of articulation, basal pubescence, and awn, behave in the  $F_1$  as partial dominants, particularly so in respect of the character of the articulation of the grain. Moreover, in the later generations there is a break-up of the fatuoid complex, and cross-over types are produced. Segregates have appeared in this cross in which the basal articulation and basal pubescence characters of the *A. barbata* parent occur in association with the awn and grain-apex of *A. brevis* type, and conversely segregates with typical *A. barbata* awns and the glabrous and normal or solidified base of *A. brevis*.

Chromosome counts in the root-tips of some of these cross-over types taken from the  $F_3$  generation made by Dr B L Sethi\* have shown them to be of diploid chromosome constitution.

The occurrence of crossing-over in the progeny of

this tetraploid-diploid cross is regarded as being highly important from the point of view of its bearing upon the chromosome constitution of fatuoids in hexaploid oats, and consequently upon theories relating to the origin of fatuoids in oats.

On the theory of the origin of fatuoids by 'chromosome aberration' as advanced by Huskins,<sup>1</sup> the chromosome constitution of the di-triploid group concerned with the fatuoid phenomenon is represented by the formulæ  $\frac{ABC}{ABC}$ ,  $\frac{ABC}{ABB}$ , and  $\frac{ABB}{ABB}$  for homozygous normal, heterozygous fatuoid, and homozygous fatuoid respectively (where *B* represents the chromosome bearing the fatuoid or *fatua* factors and *C* the chromosome bearing the factor or factors for normal or cultivated type of grain). On analogy with the *A. barbata*-*A. brevis* cross, if a chromosome bearing *fatua* or fatuoid factors pairs with a chromosome bearing a factor or factors for normal or cultivated grain, that is, if *B* pairs with *C*, as in the heterozygous fatuoid formula above, crossing-over should occur. Much fatuoid segregating material has been studied by different investigators, but so far no cross-over types have been recorded.

On the other hand, on the basis of the theory of the origin of fatuoids by mutation, as put forward by Jones,<sup>2</sup> and supported by Nishiyama,<sup>3</sup> in which the di-triploid group is represented by the formulæ  $\frac{ABC}{ABC}$ ,  $\frac{ABC}{ABC_1}$ , and  $\frac{ABC_1}{ABC_1}$  for homozygous normal, heterozygous fatuoid, and homozygous fatuoid respectively ( $C_1$  representing a mutational change in the *C* chromosome), no cross-over types are theoretically expected, and, as already stated, none so far have been found.

It appears to me, therefore, that the occurrence of crossing-over in the tetraploid-diploid cross (*Avena barbata*-*A. brevis*) gives further support to the hypothesis that fatuoids in hexaploid oats arise by mutation rather than by chromosome aberration.

E T JONES

Welsh Plant Breeding Station,  
University College of Wales,  
Aberystwyth, April 2

<sup>1</sup> Huskins, C L, *J. Genetics*, 18, 1927

<sup>2</sup> Jones, E T, *J. Genetics*, 23, 1930

<sup>3</sup> Nishiyama, I, *Japanese J. Genetics*, 7, 1931

#### Molecular Dissociation by Electron Impact

ABOUT two years ago I noticed<sup>1</sup> that the positive ions generated along the path of an electron beam nearly all came out of the electron beam at right angles to it with energies of the order of 1 or 2 volts, that is, considerably higher than their thermal energies. I found that this was due to a radial potential gradient being set up around the electron beam by concentration gradients in the electron gas surrounding the beam. The presence of these radial potential gradients would introduce considerable difficulties into the accurate measurement of the kinetic energies of the dissociation products formed by electron impact in a molecular gas, for the dissociation products possess energies of only the same order of magnitude as the energy gained in falling through the potential gradient set up by the electron beam.

In a recent investigation by Tate and Lozier<sup>2</sup> of the energies of the dissociation products of nitrogen and carbon monoxide formed by electron impact, no account has been taken of the possible existence of these radial potential gradients. It is not possible to determine from my work the value of the potential gradient in Tate and Lozier's investigation, for they worked at lower pressures, and the effect of pressure on the value of the potential gradient has not been

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investigated. There is, however, little doubt that such a radial potential gradient existed in their work, for it would account for the fact, mentioned on p. 261 of their paper, that  $N_2^+$  ions were able to reach the collector, whereas they should not have been able to do so if they possessed only their thermal energies.

Tate and Lozier find for carbon monoxide the following two processes



If the energy given to the molecule by the impact is  $V_i$  and the kinetic energy with which the atoms separate on dissociation is  $V_f$ , then  $V_i - V_f$  (which is equal to  $U_2 - U_1$  in Tate and Lozier's notation) should be less for the second process by the electron affinity of oxygen. Tate and Lozier find that it is greater, and suggest that this may be due to excitation of the products of dissociation, but point out that no excitation level of the correct energy is known. For process (1) they find  $V_i - V_f = 20.5$  volts, and for process (2)  $V_i - V_f = 22.2$  volts.

Since the ions collected are oppositely charged in (1) and (2), it is clear that a small radial potential gradient around the beam would decrease the experimental value of  $V_i - V_f$  for process (1) and increase it for process (2). If we assume a radial potential gradient of 1.2 volts to exist, we find for the corrected values

$$V_i - V_f = 20.5 + \frac{7}{4} \cdot 1.2 = 22.6 \text{ volts for (1)}$$

$$V_i - V_f = 22.2 - \frac{7}{3} \cdot 1.2 = 19.4 \text{ volts for (2)}$$

giving an electron affinity for oxygen of 3.2 volts.

From another dissociation process which they detected, namely,  $\text{CO} \rightarrow \text{C} + \text{O}^-$ , Tate and Lozier deduce an electron affinity for oxygen of zero (or 0.5 volt, assuming, as they do, an experimental error of 0.5 volt) if the products of dissociation are unexcited. If we again assume a radial potential gradient of 1.2 volts, the electron affinity for oxygen deduced from this dissociation process comes out at 4.9 volts. Values for the electron affinity of oxygen quoted by other investigators range from 3.2 volts to 8.9 volts.

Besides giving a reasonable value for the electron affinity of oxygen, the assumption of a small radial potential gradient of 1.2 volts gives better agreement between the heats of dissociation calculated from Tate and Lozier's results and the spectroscopic values given by Birge and Sponer. The heat of dissociation of the normal carbon monoxide molecule is raised from 9.3 volts to 11.4 volts, and the heat of dissociation of the ionised molecule is raised from 6.4 volts to 8.5 volts. The values given by Birge and Sponer are respectively 10.3 volts and 9.8 volts.

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The University, St. Andrews  
March 8

<sup>1</sup> *Proc. Roy. Soc., A*, 129, 361, 1930  
<sup>2</sup> *Phys. Rev.*, 39, 254, Jan 15, 1932

#### Intensity Ratio of Fluorescent X-Ray Lines

HEVESY and Alexander have recently<sup>1</sup> published some very interesting figures on the variation of the relative intensities of the  $L\beta_2$  and  $L\beta_3$  lines of silver under fluorescent excitation by primary X-radiations of varying frequency.  $L\beta_2$  is  $L_{III} \rightarrow N_V$  and  $L\beta_3$  is  $L_{II} \rightarrow M_{III}$ . The reported change in the intensity ratio is from 100:25 at 2.6 Å to 100:60 at 1.3 Å.

This change is, as the authors point out, in the same direction as that previously noted by Skinner, and in the direction indicated by my work on X-ray electrons. I have, unfortunately, no data which are directly

applicable to this particular case, but from earlier published work and from more recent unpublished experiments I have been able to construct a rough curve which allows a rather hazardous extrapolation to be made to the region covered by Hevesy and Alexander's work. From this curve I should expect the intensity ratio of  $L\beta_2$  to  $L\beta_3$  to change by not more than about 30-40 per cent between 1.3 and 2.6 Å — very appreciably less than the 140 per cent reported by Hevesy and Alexander.

I am surprised that the discrepancy should be so large. Hevesy and Alexander's measurements are more direct and, I should imagine, more exact than mine in this particular respect, and I shall be interested to see the detailed account of their work. I hope that I may shortly be able to extend the measurements further in this direction by the photoelectric method, and possibly get some clue to the reason for this discrepancy between the two results. Some degree of extrapolation is inevitable, for technical reasons, in the photoelectric method, but I may say that my extrapolated curve agrees as well as can be expected with Kellstrom's measurements of the silver  $L$  absorption discontinuities.<sup>2</sup>

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March 23

<sup>1</sup> *NATURE*, 129, 315, Feb. 27, 1932  
<sup>2</sup> *Z. f. Physik*, 44, p. 269, 1927

#### The Highest Oxide of Rhenium

IN the course of an investigation of the oxides of rhenium in progress in these laboratories, we have sought to repeat the preparation of the highest oxide described by I and W. Noddack,<sup>1</sup>  $\text{Re}_2\text{O}_9$ , which was obtained by them on heating the heptoxide below 150° in a stream of oxygen. The yellow heptoxide used in the Noddacks' preparations melted at 220° and gave rise to a white sublimate at 150° described as  $\text{Re}_2\text{O}_9$  and possessing the property of decolorising acidified potassium permanganate. The melting point of our specimens of heptoxide has invariably been about 300°, and this material failed to give any evidence of a white sublimate when heated in a stream of oxygen to temperatures below its melting point. Moreover, quantitative experiments repeatedly showed that its formation was unattended by any increase in weight. The sublimate was identical in crystalline form with the heptoxide, was decidedly yellow, and melted to a yellow solid, also indistinguishable from the heptoxide.

It has been known to us for some time that the melting point of the heptoxide is depressed by traces of moisture, and a specimen the melting point of which had thus been lowered approximately to 150° was found to give a white sublimate of the non-crystalline form illustrated in the Noddacks' paper, though there was no gain in weight through the conversion. In no case did any of the sublimates when carried in an oxygen stream into dilute permanganate show the slightest decolorising effect, and we are compelled to the conclusion that, in the absence of further evidence, the heptoxide must be regarded as the highest oxide of rhenium stable under ordinary conditions. A full account of this work will be published elsewhere.

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A. J. RUDGE

Armstrong College,  
University of Durham,  
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<sup>1</sup> *Z. anorg. Chem.*, 181, 37, 1929  
<sup>2</sup> *Biltz and Leire, Nachr. Ges. Wiss.*, 191, 1931



## Research Items

**A Choctaw Account of the Flood**—The Smithsonian Institution has issued a summary of a report to be published in due course by Dr J R Swanston on an investigation of the culture and legends of the Choctaw Indians, which includes an account of the Flood—a tradition which the Choctaw shared with other south-western Indians. It gives an account of the destruction of mankind by the waters because of their wickedness. The form of the tradition as given here preceded the advent of the white missionaries. Later versions were modified to conform with the account in Genesis. A divinely pre-warned prophet went from village to village, proclaiming the coming of the flood, but no one heeded. Darkness, cold, and thunder came and the food of the Indians became mouldy and unfit to eat. Wild animals from the forest gathered around the camp-fires. Great waters rushed over the land from the north and destroyed everything. The prophet alone was saved. He made a raft of sassafras logs, upon which he floated for many weeks. A black bird circled over his raft, but when the prophet asked for help, it sailed away. Then a blue bird with red eyes guided him to an island in the direction of sunrise. The prophet landed and lay down in the mud to sleep. When he awoke, he found the island covered with all kinds of animals. Among them were the black bird and the blue bird. The black bird became the raven, a bird of ill-omen ever afterwards, but the blue bird became a beautiful woman, the mother of the new race of men. The Choctaw believe in a 'Great Spirit', which is closely associated with the sun, but can assume human form. Every man has two souls, of which one, identical with the shadow, is left behind after death and wanders about its former abode howling, while the other, "the inside shadow", goes to Paradise, an Elysium on earth of eternal springtime and perpetual youth, reached by crossing a yawning chasm by a slippery log.

**Influence of Pituitary on the Ovaries**—It is now well known that one or more hormones from the anterior lobe of the pituitary gland regulate the functions of the ovaries in mammals. The evidence has been obtained almost entirely by transplantation or injection of extracts of the gland, since operative removal in mammals is difficult. L. Hogben, E. Charles, and D. Slome have now supplemented the previous evidence by showing that, in *Xenopus laevis*, removal of the pituitary gland or of the anterior lobe alone produces involution of the ovaries, as well as a lowering of the serum calcium and cessation of skin secretion (*J. Exp. Biol.*, 8, 345, 1931). *Xenopus* was chosen for the experiments since it survives hypophysectomy for a prolonged period. After the complete operation the animals remain pale on a black background, the melanophores being permanently contracted, after removal of the anterior lobe alone, however, the animals remain dark even when subjected to conditions which would otherwise produce pallor. The involution of the ovaries occurs after either operation, but is more marked after removal of the anterior lobe alone. Conversely, it was found that ovulation could be induced midway between breeding seasons by injections of extracts or by implantation of the anterior lobe also, injection of extracts, especially of the posterior lobe, induces a copious secretion of slime from the skin after a few minutes. Hence it may be concluded that the anterior lobe of the pituitary has a functional influence on the ovaries throughout the vertebrate series.

**Immunology in Reptiles**—The immunological reactions of certain reptiles have recently been investigated by E. Crasset and A. Zoutendyk (*Publ. South African Institute for Medical Research*, vol. 4, p. 377, 1931). The results indicated quantitative rather than qualitative differences from the responses of mammals, and different species of reptiles showed very varying degrees of susceptibility. Thus lizards and chameleons are, in general, the most susceptible to tetanus toxin, and may be killed by a dose almost equal to that which kills guinea-pigs, although the incubation period is much longer. One species of lizard, the leguaan, however, was quite resistant to both tetanus and diphtheria toxins. Crocodiles, snakes, and tortoises show increasing degrees of resistance to tetanus toxin, but crocodiles and tortoises are as susceptible to diphtheria toxin as mammals, the lizards, and especially the snakes, being resistant. Reptiles are usually resistant to dysentery and typhoid. Intoxication is the more readily produced the higher the temperature to which they are exposed. Although differences in susceptibility to different toxins are common among mammals, the processes involved in the immunity reactions appear to be different in mammals and reptiles. Reptiles show a very low and extremely slow response to the introduction of antigen, whether they are susceptible or resistant to the toxin. The sensitivity of the cells for toxin does not have as its corollary an aptitude for the production of antibodies. Hence immunity appears to follow the evolution and specialisation of the animal species, which result in a higher differentiation and sensitivity of the specialised cells. These, so far as immunity phenomena are concerned, are characterised by a higher and more rapid aptitude of response, which has as its object the protection of the organism.

**Nephridiostome of the Earthworm**—Prof. E. S. Goodrich (*Quart. J. Microsc. Sci.*, vol. 75, pt. 1, 1931) has critically re-examined the structure and development of the funnel or nephridiostome of *Lumbricus*. He gives a detailed description of the upper and lower lips of the funnel and of the relations and structure of the canal-, gutter-, central, and marginal cells. The account of the development of the funnel is traced from the time when the nephridium consists of a post-septal string of cells reaching obliquely backwards from the septum to the epidermis and ending anteriorly in a large funnel-cell bulging forwards through the coelomic epithelium of the septum into the next segment. The whole nephridiostome (excluding the covering of coelomic epithelium and the connective tissue) is shown to arise from the nephridial rudiment, wholly or partly from that part of the funnel-rudiment which is derived from the funnel-cell. Upper, lateral, and lower lips are all developed from the funnel rudiment, in which the lumen, appearing first as a notch between upper and lower lips, becomes pierced. There is no evidence that the coelomic epithelium contributes any part of the nephridiostome. The view sometimes put forward that the excretory organ of *Lumbricus* is a nephromixium such as is present in some families of Polychaeta is not founded on sound evidence. A. Meyer, who gave an account (1929) of the development of the funnel in *Tubifex*, concluded that the nephridioblast from which the whole nephridium developed was situated on the anterior surface of the septum among the cells of the coelomic epithelium and was derived from this epithelium. Prof. Goodrich, who has seen Meyer's preparations, is convinced that Meyer is mistaken and

that he failed to trace the origin of the nephridioblast, and he adds "There seems to be no justification for Meyer's extraordinary theories concerning the general morphology of nephridia and genital ducts in the Annelida."

**Inhibition of Potato Sprouting by Ripe Apples**—A novel and simple means of preventing potatoes from sprouting even up to so late as June, was recently described by Dr O H Elmer of the Kansas Agricultural Experimental Station, in a *Science Service Bulletin*. Tests have shown that if ripe apples are stored with potatoes in a well-closed bin, sprouting is prevented, the tubers remaining firmer and of better quality than those stored without the apples, and in experiments with previously sprouted tubers, provided the shoots were within 'smelling distance' of the apples, their growth was checked. The nature of the substance which is responsible for this effect is not known, but it evidently occurs in ripe apples only, for neither green nor rotten fruit was able to bring about the same result. Further, the substance does not occur in the skin only, for peeled apples were equally efficacious. Apparently only apples and closely related fruits, such as pears, possess this property, for neither bananas nor oranges were found capable of exerting the same influence on the potatoes.

***Puccinia Malvacearum*, a Homothallic Rust Fungus**—The work of Craigie on the heterothallism of certain rust fungi has stimulated much research into the behaviour of other species of the Uredinales. Miss Dorothy Ashworth has adopted a very ingenious method of single-spore inoculation and has shown that the object of her study is homothallic ("*Puccinia Malvacearum* in Monosporial Culture", *Trans Brit Mycol Soc*, vol 16, parts 2 and 3, pp 177-202, Dec 1931). There appears to be an autoecious mechanism for diploidisation similar to that described for *Coprinus* by Buller and others. Three or four haploid cells are formed from the diploid sporidium shortly after its entrance into the host, and each sends out a thin vegetative mycelium which ramifies extensively in the mesophyll of the host leaf. Diploidisation of this vegetative structure is brought about by nuclear migration and by division without the formation of a septum. It takes place in numerous distinct patches, the sites of the future teleutospore sori. No fusion of cells has been observed.

**Vacuum Pump Liquids**—The search for more suitable liquids for use in diffusion pumps on the lines suggested by Mr C R Burch in these columns (*NATURE*, 122, 729) and continued by Messrs K C D Hickman and C R Sanford (Patent 329,918) has led Drs M von Brandenstein and H Klumb of the Physical Institute of the University of Berlin to devise a special form of pump for such liquids, and an account of their work has now been published (*Physik Z*, Jan 15). They conclude that it is possible with both oils and fats of low vapour pressure to produce vacua of the order  $10^{-3}$  dynes per sq cm. The Eastman Kodak Co has published a list of suitable liquids with low vapour pressure, and Prof P W Bridgman has investigated the compressibilities of a number of them in the Jefferson Physical Laboratory of Harvard University (*Proc Amer Acad Arts Sci*, vol 67). He finds that as the number of OH groups in an organic molecule increases, the compressibility decreases, that glycerine is the least compressible, and that organic liquids of other groups have compressibilities from three to five times as great.

**Supposed Spontaneous Transformation of Helium into Radiation**—Dr L H Gray and Mr G T P

Tarrant have contributed a short paper to the January number of the *Proceedings of the Cambridge Philosophical Society*, describing an attempt to detect the spontaneous transformation of helium into penetrating radiation. If this occurred it might, as Sir James Jeans has shown (*NATURE*, 127, 594, 1931), account for the existence of the extremely penetrating rays found by Regener by measurements in deep lakes. In the present experiments, an ionisation chamber containing nitrogen at a pressure of 100 atmospheres was exposed to five kilograms of helium at a mean distance of 45 cm, but instead of increasing the ionisation, presence of the helium reduced it to a slight extent, since the containers of the gas acted as additional shields protecting the chamber from the cosmic radiation and from  $\gamma$ -radiation from the walls of the room. After allowing for these effects, no ionisation remained which could be attributed to the helium. The limit of accuracy in the measurements was equivalent to a half period for the destruction of helium in this way of more than  $10^{18}$  years, or expressed alternatively in terms of the observed penetrating radiation from cosmical sources, the upper limit for the ionisation which might be produced if the whole of matter in interstellar space were helium is about two hundred times that actually produced at the surface of the earth by the penetrating radiation.

**Photographs of Fast Protons**—A pamphlet published by the Carnegie Institution of Washington (Feb 28), which deals with work done in its Department of Terrestrial Magnetism by Messrs M A Tuve, L R Hafstad, and O Dahl, contains a photograph of cloud trails of fast protons which had been produced by ordinary electric means. The full detail of this work is not described, but there are some excellent photographs of the lay-out of the apparatus and of the Tesla coil used. The proton trails given are too crowded to show their individual features, but seem to be fairly homogeneous in length, and to have an appearance not obviously to be distinguished from close sheafs of  $\alpha$ -particles, such as have been photographed by Meitner. It appears that this is the first occasion on which tracks of massive particles, as distinct from electrons, produced by other than radioactive methods, have been obtained.

**Ortho- and Para-Hydrogen**—In No 29 of the *Conférences d'actualités scientifiques et industrielles* (Paris Hermann, 1931) Prof E Darmais gives a very clear account of the theories underlying the existence of the two forms of molecular hydrogen and of the experiments which led to their detection and isolation. He points out that their existence was inferred from observations on the secondary spectrum, due to the molecule of hydrogen, the alternation in intensities in the lines of which was pointed out by Mecke in 1924. McLennan and McLeod showed in 1929 that the existence of two kinds of molecules in the liquid was indicated by the Raman spectrum, and Dennison in 1927 had inferred the same result for the gas on the basis of its specific heats, which could not be brought into line with the moment of inertia of the hydrogen molecule, found spectroscopically by Hori in the same year, without an assumption of two kinds of molecules. The isolation of the two forms by Bonhoeffer and Harteck in 1929, by making use of the catalytic effect of charcoal at low temperatures, confirmed all these results, and in particular the abnormal specific heat curve of hydrogen. Eucken and Hiller in 1929 were able to reproduce this curve from those of ortho- and para-hydrogen. The paper includes a short bibliography.

**Physico-chemical Study of Rare Earth Sulphates**—Prof B Brauner, with Dr E Švagr, has contributed

a lengthy paper to the *Collection of Czechoslovak Chemical Communications* (February 1932) on the sulphates of the rare earth metals, scandium, yttrium, lanthanum, praseodymium, neodymium, samarium, gadolinium, terbium, erbium, ytterbium, and thorium. The salts were prepared from the purest materials available and most of them have been used for atomic weight determinations by conversion into the metal oxide through ignition. The results are compared with those of Homgshmid, Štěrba-Bohm, Baxter, Urban, and other investigators, and the possible sources of error are discussed. The conclusion is reached that the classical sulphate method, which serves well for orientation in the fractionation of rare earth mixtures, is not exact enough for atomic weight determinations. One source of error which has probably not hitherto been taken into account is that the oxides, after glowing and cooling, absorb oxygen from the air and thus become heavier and give a figure for the atomic weight which is too high. Among the physico-chemical investigations carried out by the authors were determinations of the conductivities of the aqueous solutions of the normal and acid sulphates. Estimations of basicity were studied by the inversion of cane sugar and by the rates of hydrolysis of methyl acetate. Thorium sulphate,  $\text{Th}(\text{SO}_4)_2 \cdot 9\text{H}_2\text{O}$ , and the acid salt,  $\text{Th}(\text{SO}_4)(\text{SO}_4\text{H})_2$ , the only thorium hydro-

gen sulphate obtained in these researches, showed anomalous behaviour compared with the other rare earth sulphates. This the authors attribute to the tetravalence of thorium.

**Corrosion Fatigue of an Aluminium Crystal**—The results of a life-test on an aluminium crystal, subjected simultaneously to an alternating shearing stress and to corrosion by tap-water, have been described by H. J. Gough and D. G. Sopwith (*Proc. Roy. Soc.* for March). It withstood in all more than 23 million cycles before fracturing, which was due to profuse cracking. Plastic deformation was observed only in the initial stages, but there was a continual growth of small surface pits, which tended to run together, and although they did not lead to failure in this case, might conceivably have done so. The main cause of failure proved to be corrosion on the site of previously formed slip bands. Due to this a large number of big cracks developed, and a multitude of smaller ones, in nearly every case parallel to the traces of the operative slip planes, and most thickly concentrated in the region of maximum resolved shear stress intensity. These were, in general, the results anticipated, and the experiments are now to be extended to an iron crystal, with the applied cycle of stress such as would not normally produce plastic deformation.

### Astronomical Topics

**Houghton's Comet**—Prof. H. E. Wood has computed the following orbit of this comet, which was telegraphed by Dr. Spencer Jones to the I. A. U. Bureau at Copenhagen:

|          |                       |
|----------|-----------------------|
| $T$      | 1932 April 20 080 U T |
| $\omega$ | $1^\circ 44'$         |
| $\Omega$ | 205 41                |
| $i$      | 75 39                 |
| $\log q$ | 0.06472               |

#### EPHEMERIS FOR 0<sup>h</sup> U T

|          | R. A.                                           | N. Decl. | $\log r$ | $\log \Delta$ |
|----------|-------------------------------------------------|----------|----------|---------------|
| April 23 | 12 <sup>h</sup> 27 <sup>m</sup> 16 <sup>s</sup> | 27° 30'  | 0.0650   | 9.3219        |
| 27       | 12 22 24                                        | 42 48    | 0.0667   | 9.4526        |
| May 1    | 12 19 24                                        | 51 17    | 0.0696   | 9.5665        |
| 5        | 12 17 28                                        | 56 21    | 0.0737   | 9.6606        |
| 9        | 12 16 52                                        | 59 37    | 0.0789   | 9.7592        |
| 13       | 12 17 12                                        | 61 48    | 0.0852   | 9.8055        |
| 17       | 12 18 24                                        | 63 20    | 0.0924   | 9.8624        |

The comet passes within some 15 million miles of the earth, and may be faintly visible to the naked eye, its northward motion is extremely rapid, owing to the high inclination. It moves nearly from pole to pole in two months. The elements bear considerable resemblance to those of comet 1849 II, which may indicate a common origin, identity is not possible, as that comet was observed for five months and its orbit was slightly hyperbolic.

**The Delporte Planet**—The planetary nature of this body is now established, and it has been given the designation 1932 EA<sub>1</sub>, pending the assignment of a permanent number later on. The orbit is a difficult one to compute, and the period is not yet known with precision. The following elements by Dr. A. C. D. Crommelin use observations up to April 11, and are probably not very far from the truth.

|          |                      |
|----------|----------------------|
| $T$      | 1932 April 4 808 U T |
| $\omega$ | $25^\circ 18' 49''$  |
| $\Omega$ | 171 8 51             |
| $i$      | 12 10 16             |
| $\phi$   | 26 38 17             |
| Period   | 2.767 years          |
| $\log q$ | 0.03617              |

The least distance from the earth's orbit is about ten million miles, which is only two-thirds of that of Eros.

Unfortunately, the discovery came too late to utilise the present approach, which is the most favourable one possible, for a parallax determination. On many nights, observations were taken at intervals of several hours, these, when corrected for the motion in the interval, indicate a horizontal parallax in the neighbourhood of 80". These parallax determinations helped in deducing the distance from the earth, and in deciding against a parabolic orbit.

It is very desirable that large instruments should follow the object as long as possible, to facilitate its recovery at the next favourable opposition, it will probably only be observable when opposition occurs fairly near perihelion.

The following ephemeris is for 0<sup>h</sup> U T

|          | R. A.                                           | N. Decl. | $\log r$ | $\log \Delta$ |
|----------|-------------------------------------------------|----------|----------|---------------|
| April 25 | 16 <sup>h</sup> 41 <sup>m</sup> 12 <sup>s</sup> | 38° 27'  | 0.0453   | 9.2910        |
| 27       | 16 45 24                                        | 38 18    | 0.0471   | 9.3063        |
| 29       | 16 50 12                                        | 38 4     | 0.0490   | 9.3214        |
| May 1    | 16 54 12                                        | 37 46    | 0.0510   | 9.3358        |
| 3        | 16 57 6                                         | 37 28    | 0.0532   | 9.3497        |
| 5        | 16 59 24                                        | 37 9     | 0.0556   | 9.3633        |
| 7        | 17 1 46                                         | 36 46    | 0.0580   | 9.3763        |
| 9        | 17 3 44                                         | 36 23    | 0.0605   | 9.3890        |

**Annual of Catania Observatory for 1932**—This annual publication gives, in addition to the usual contents of an astronomical almanac, a useful list of periodic comets, notes on the eclipses, and the planetary phenomena of the year. There is a special chapter on Eros, of which many photographs were secured at Catania both in 1900-1 and at the recent apparition. A portion of one of the latter plates is reproduced, a number of short exposures being given on the same plate, a sufficient time-interval being given to separate the images of Eros owing to its rapid southerly motion. A table shows that steady progress is being made in the publication of the zone of the astrographic catalogue undertaken by the observatory, some of the reductions are being carried out at Naples. Solar spectroscopic work is also carried out. Drawings of four of the most interesting prominences observed in 1931 are given, the dates are March 1, April 10 (two prominences), and May 24. There are also drawings of sunspot groups on Feb. 23 and March 12.

## Research in Textiles

IN a recently issued report on the work carried out in the Clothworkers' Departments, University of Leeds, under a research scheme established in 1928 by means of a grant of £3000 a year from the Worshipful Company of Clothworkers, reference is made to the value of the scheme not only in promoting a research plan, which has already a number of fundamental discoveries to its credit and holds promise of further work of outstanding scientific and technical importance, but also in providing industry with scientifically trained men. The report presents a survey of the three years' working of the scheme and is not confined to a statement on a single year. It is pointed out that the scheme has led directly to the creation of a school of textile research in Great Britain which has already attracted advanced workers from other countries. It is hoped that the recent creation of an honours degree of BSc in textiles will assist in discovering students who will devote themselves to continuous work in this field, and it is strongly urged that the research grants for fellowships or scholarships in colour chemistry should be put on a permanent basis in 1932. The importance of adequate research scholarships being available in periods of industrial depression is specially stressed.

The survey of work in textile physics stresses the value of the results obtained by the application of X-rays methods, to which frequent reference has been made in NATURE. The combined evidence of chemical and X-ray analysis has led to the conclusion that the structure and properties of common industrial fibres are based on three main fundamental principles: long, thin crystalline or pseudo-crystalline particles, with their long dimensions inclined at a constant angle to the fibre axis, as in cotton, or parallel to the fibre axis, as in ramie, silk wool, etc. If the molecular chains are inextensible the fibres can be stretched only by making the molecular bundles slip over one another, examples being cellulose fibres, natural silk, stretched wool and other animal hairs, and stretched rubber. If, as in cellulose and silk, the straight molecular state is the normal state, there is only a limited power of recovery from extension. If, however, the molecular chains are themselves extensible, as in unstretched wool, hair, and unstretched rubber, the fibres can be stretched to abnormal dimensions and afterwards recover their original length exactly.

Further investigations have shown that by various methods wool can be contracted to half its original length, while X-ray studies on the permanent set of stretched wool and hair have revealed that steam acts on the extended molecules so as to prevent their contraction to the folded state. The process is analogous to the vulcanisation of rubber, and detailed results of the 'setting' of wool by steam will shortly be published. X-ray analysis of fibres has not only supplied strong evidence in support of the chain theory of protein structure but also is now furnishing important information about the actual growth of cellulose in Nature, and X-ray photographs of the wall of *Velonia ventricosa* promise to throw light on

one of the greatest problems in botany and agriculture. X-ray photographs of the structure of feathers have also shown that feathers and tortoise-shell give a common X-ray photograph which is different from that of wool and hair, and accordingly the classification of their fibrous protein with the keratin of wool, hair, horn, etc., in most textbooks is incorrect.

On the physico-chemical side, the studies of the elastic properties of wool which have already indicated the underlying causes of the permanent setting of hair have now led to the discovery, of far-reaching importance for wool-finishing processes, that the 'set' imposed at any one temperature is permanent only to water at a lower temperature than that at which it was imposed. This and the subsequent discovery that caustic soda solutions have the same property of being able to eliminate permanent set have led to the development of two new finishing processes for producing crêpon effects.

Investigations on the relation of rigidity to the amount of moisture present in the fibre and to atmospheric humidity showed that while the breaking load of wool fibres is only reduced in the ratio 1.5 : 1 by a change from absolute dryness to saturation with water, the rigidity changes in the ratio 15 : 1, and thus afforded an explanation why artificial humidification is essential for spinning mills but relatively unimportant at other stages of manufacture. Further explanation of variations in the spinning properties of wool has been found in the discovery that the affinity of wool for water decreases as the temperature at which it is dried increases.

These investigations not only make an important contribution to the knowledge of the structure of wool but also afford explanations of important technical points, such as fastness to rubbing. Most wool dyes are smaller in particle size than the pores of the swollen wool fibre and penetrate to the interior of the fibre. Dye molecules or particles which are larger in size than the pores of the swollen fibre can only be absorbed at its external surface, and the dye is accordingly readily removed by rubbing.

Other recent work has shown that acids have the property of attacking and subdividing the micelle structure itself, rendering the fibre easier to stretch. The further discovery that wool is completely immune to attack by acid and alkali over a wide range, known as the pH stability region, not only affords a striking and independent confirmation of Svedberg's results on soluble proteins, but is also of considerable significance in relation to wool scouring. It has also been possible to establish definitely the nature of one of the linkages in the wool molecule and thus to show that the combination of wool with acids and acid dyes is a strictly chemical process. The further discovery that at high temperatures the wool micelles are subdivided by water alone has a profound significance for the acid dyeing of wool. Space does not permit further reference to numerous other more technical researches which among other points have established the importance of perfect elasticity as well as surface scale structure for milling shrinkage.

## Standardisation of Screw Threads

IN the *Human Factor* (vol 6, No 2) there is an interesting article by W F Watson, a working mechanic of thirty years' experience, describing the conflict between the duodecimal and decimal systems of measurement in his domain. He surveys the history of the two systems of measurement in the various

countries, and the gradual success of the decimal, except in England. He illustrates the trials of the turner and manufacturer, by a study of screw threads.

The first attempt at securing uniformity in screws was made by Sir Joseph Whitworth in 1841, and in the course of twenty years the Whitworth system

was the recognised standard for general engineering purposes. Prior to that, each firm had its own 'standard' set of screwing tackle, the existence of which made engineering repairs costly and inconvenient. Owing to the pre-eminent position occupied by British engineering, the establishment of a British system was very favourable, and no difficulty was experienced in securing the adoption of Whitworth screws in Germany and the United States.

The two great attacks made on the Whitworth system came from the Franklin Institute in 1864, when the Sellers thread was adopted and recommended to American engineers, and in 1873, when Delisle of Karlsruhe initiated a metric system. In 1918 the International Screw Thread Congress adopted the international metric screw thread. Now the metric system of screw threads is standardised on the continent of Europe, America has its Sellers standard, whilst Great Britain retains the Whitworth system.

It is said that the threads now recognised as standards are included in about eight great systems,

but a popular handbook gives details of no fewer than thirty different kinds of screw thread. As an example of the practical confusion arising, Mr. Watson says that if we place side by side a half-inch American screw, an English half-inch screw, and a 12 mm screw (2 mm pitch), it is not easy to note the difference. The American screw has, however, 13 threads to the inch, the English 12, and the metric 13.7, and the angles are 60°, 55°, and 47.5° respectively, therefore each must have its special nut. As in these days engineers are constantly handling the products of other countries, and as two different systems of screws may be employed on the same machine, much time is wasted in finding the standard used and in trying to get a screw conforming to that standard.

A similar difficulty is experienced in wire and sheet metal gauges. It may be suggested that the time is ripe for the various bodies concerned to examine all sides of the question, with the view of securing the adoption of an international system of measures for all commercial purposes.

### Embryology of the Slime Eels \*

THE Myxinoidea or slime eels have been the subject of inquiry and discussion by many investigators in both Europe and America. Much difference of opinion for a long time existed, and even yet remains, with regard both to the facts concerning them and to their interpretation. So little were these animals at first understood that the earliest investigators classified them with the worms. This error was early rectified, but great controversy continued to centre round such questions as whether the Myxinoids are or are not parasitic, whether they are primitive or degenerate, and whether they should be classified as Gnathostomata or Agnathostomata.

On the last question agreement had almost been reached, most morphologists and embryologists having placed them in the former group, when recently a sole investigator who has arisen in the field of myxinoid palæontology, stoutly claims for them a place in the latter. The excretory system has been described by some workers as a pronephros, by others as a pronephros which eventually becomes transformed into a mesonephros, and by still others as a small pronephros and a posterior segmental mesonephros which develops in the usual manner. The reproductive system, too, has been very extensively studied. Because of peculiarities in the structure of the generative organ, the myxinoids have long been believed to be functional hermaphrodites—in fact, they are still definitely stated to be so in even the most recent textbooks.

For many years the assistance of embryology in solving these and other problems connected with this difficult group was denied, because no one was able to find embryos developing in their natural environment or to obtain them by keeping the 'eels' in captivity. Neither did palæontology contribute towards their elucidation, for until quite recently no fossil cyclostome had been found—with the possible exception of *Palæospondylus*, supposed by some to be a Devonian lamprey. This belief, however, was firmly rejected by Dr. Bashford Dean, by whom many valuable contributions to our knowledge of the Myxinoidea were made during the time that he was professor of zoology at Columbia University.

From examination of his notebooks, it seems quite

certain that this industrious and talented investigator had intended some day to publish still further information which he had gleaned, especially on the genital system of *Bdellostoma*. It is particularly fitting, therefore, that the Bashford Dean Memorial Volume on "Archaic Fishes" should contain this section on the Myxinoidea based on the unpublished data left by Dr. Dean in the form of notes, graphs, tables, and sixteen excellent drawings. This contribution to the volume is written by Prof. Leroy Conel, who for twelve years was associated with Dr. Dean in his work.

This author, before presenting Dr. Dean's notes and data (dealing mainly with the reproductive system of *Bdellostoma*), gives a brief but very useful review of the previous literature on the subject, in which the problems which Dr. Dean set out to solve are clearly indicated. *Myxine glutinosa*, the representative of the group mainly studied by previous workers, was stated by Nansen (1887) to be a functional protandric hermaphrodite. Cunningham (1891), though disagreeing with some of Nansen's observations, came to the same conclusion. In 1899 Dr. Dean published a paper in which he expressed grave doubts as to the truth of this assumption—doubts which were later supported in the publications of A. and K. E. Schreiner (1904-8). These authors held that, though undoubtedly hermaphrodite in structure, *Myxine* is functionally dioecious.

On account of this uncertainty concerning the true state of affairs in *Myxine*, Dr. Dean, in search of further evidence, turned his attention to other members of the group, *Bdellostoma stouti* and *B. burgeri*. In these he found the gonad of each individual examined to be definitely either a testis or an ovary, and concluded that both species of *Bdellostoma*, at least, are very rarely, if ever, hermaphrodite at any stage of their life history. This finding, he contended, made it still more difficult to believe that the closely related *Myxine* is a functional hermaphrodite. In 1896, in order still more fully to investigate the life history of the Myxinoidea, Dr. Dean sought for, and succeeded in finding, a large number of embryos of *B. stouti* at Pacific Grove, in Monterey Bay, California—the first fairly complete series of myxinoid embryos ever collected. This material enabled him, in 1899, to publish an account of the embryological development of this species. In 1900 and 1901 he made a similar, though less successful, attempt to

\* The Bashford Dean Memorial Volume "Archaic Fishes" Edited by E. W. Guider. Article 3. The Genital System of the Myxinoidea. A Study based on Notes and Drawings of these Organs in *Bdellostoma* made by Bashford Dean. By Prof. J. Leroy Conel. Pp. 63-102 + 4 plates. (New York: American Museum of Natural History, 1931.)

collect embryos of *B. burgeri* along the coast of Japan

While searching for embryos, Dr Dean recorded in his field notes many observations which contribute towards answering the question of the breeding season and spawning period of these species. From the data thus collected he came to the conclusion that the spawning time of *Bdellostoma* is during late August, all of September, and the first three weeks of October. This finding is completely at variance with a statement made by him in 1899, in which he says that "embryos can be obtained during the late fall and early winter in stages which enable me to extend the known season of ovulation throughout the whole year. A time of optimum spawning probably occurs, and this I believe to be the last of spring and the first month of summer." In the absence of more definite data from other workers, these two differing views serve but to emphasise the fact that the spawning time of the Myxinoidea is still unknown.

All investigators in these and allied fields of research will be exceedingly grateful to Prof Conel for collecting and arranging these notes, graphs, and drawings of the late Dr Dean, and to the trustees of the American Museum who have made possible their publication. Here and there in the paper the writer has added some of his own observations and conclusions. For the purpose of presenting more clearly and of emphasising the significance of Dr Dean's work, this was perhaps necessary—even inevitable. Nevertheless, although Prof Conel's contributions consist chiefly of corroborations of Dr Dean's observations, it is unfortunate that not infrequently the reader is provided with insufficient clues to enable him to decide which of them is responsible for a given observation or deduction. G. A. S.

### University and Educational Intelligence

LONDON—The degree of D Sc in Chemistry has been awarded to Mr. A. A. Goldberg (Imperial College—Royal College of Science) for a thesis consisting of three papers entitled (1) "The Synthesis and Orientation of Trichloroanthraquinones and Amino Disulphonates of Anthraquinone", (2) "The Rational Synthesis of 1,3-Dichloroanthraquinone", and (3) "The Reduction of Nitroanthraquinone Sulphonic Acids" (*J. Chem. Soc.*, 1931-32).

Of the State school supervisory agencies used by local education authorities in America one of the most important is the circular letter. A collection of specimen letters, addressed chiefly to rural school teachers, is published as *Bulletin* No. 19, 1931, of the Office of Education, Washington. They give some idea of how the wheels of the State school machine go round, and of the multifarious duties that fall to the lot of the school superintendents, some thousands of whom assembled in February at Washington under the auspices of the National Education Association. The February number of *School Life*, the organ of the Federal Office of Education, is devoted largely to topics of special interest to them.

THE "Hygiene and Physical Education" chapter of the forthcoming Biennial Survey of Education in the United States, 1928-1930, has been issued as *Bulletin* No. 20, 1931, of the Office of Education, Washington, and almost simultaneously has appeared "White House Conference, 1930—a condensed report of America's children, their health, education, training handicaps, etc., as analysed by 1200 experts working on 150 committees", obtainable (price 50 cents) from the office of the White House Conference on Child

Health and Protection, Interior Department Building, Washington, D. C. There has recently been conducted in connexion with this conference an investigation, such as has not taken place since 1923, of American public school medical and dental work and health and physical education, and the results of the investigation are summarised in this bulletin. It appears that in such matters as high school playgrounds, gymnasia and swimming-pools, and health examination of children attending, or soon to attend, elementary schools, there has been during the past seven years a marked improvement. In universities and colleges the answer to "the insistent demand that students should know more about wise living and the care of their bodies" seems to have been in most cases rather perfunctorily met by optional courses in hygiene, and college entrance requirements have, through lack of recognition for entrance credit of physiology and hygiene, tended to distract attention from the needs of health teaching in secondary schools. There has been in recent years a remarkable development of interest on the part of colleges, universities, and teachers' colleges in summer camps and the opportunities they offer of health cultivation.

### Calendar of Geographical Exploration

April 25, 1900—Italian Polar Expedition

Capt. Cagni reached 86° 34' N in 65° 20' E. The Italian expedition of H. R. H. Prince Luigi, Duke of the Abruzzi, had sailed in 1899 in the *Stella Polaris* by way of Franz Josef Land. The winter was spent in Tephtz Bay, Rudolf Island, and in the spring an attempt was made to reach the north pole by sledging over the ice. Frost-bite disabled the Duke, and Capt. Cagni therefore led the northern party, starting on March 10, 1900, with ten men and nearly a hundred dogs. Before losing sight of Rudolf Island, three men turned back—and were never seen again. A second party returned safely from lat. 83° 10' N, but Cagni, with three companions, reached the above point; no land was visible at the farthest north. Cagni had to turn back because the food supply was giving out; the return journey took sixty days, as against forty-five for the outward. Much had been achieved, though the pole itself had not been reached.

April 26, 1848—A. R. Wallace and H. W. Bates

A. R. Wallace and H. W. Bates left Liverpool for Para, where they stayed for eighteen months, and thence made excursions to the Tocantins, Cameta, and the junction of the Rio Negro and the Amazon. Thence Wallace went to the Orinoco, and returned to England in 1852. Bates proceeded up the Amazon to Ega, where he remained for a year. In October 1857, Bates again set out from Para, and settled at Santarem for three and a half years, from which point he made numerous expeditions. For another four years he was at Ega, and then set out on an expedition to the foot of the Andes, but at Fonteboa he was compelled by illness to return, after having travelled 1400 miles up the great river. His book, "The Naturalist on the Amazons", is not only of scientific value, but also has a charm which still attracts the general reader. During his eleven years' stay he collected 8000 species of insects new to science. Wallace's collections, except for some sent on in advance, were lost in a fire at sea on the return journey. In 1854-62, Wallace made a tour in the Malay Archipelago. He divided it into two groups, according as their zoological affinities were Oriental or Australian. A narrow belt of sea, known as 'Wallace's Line', between the Oriental Borneo and



Bali on one side and Celebes and Lombok on the other, indicates an emphatic divergence between the indigenous mammalia of the respective regions

#### April 27, 1404 —Claviyo in Samarkand

Ruy Gonzales de Claviyo, a nobleman of Madrid, left Trebizond. He had set out from Spain in 1403 as an envoy of Enrique III, King of Castile and Leon (1390–1406), to the court of Timur. He was a keen and intelligent observer and kept a detailed record of his travels. From Trebizond he journeyed by land to Tabriz, crossed the Kara Kum desert, and reached Samarkand. He described the 'Iron Gates', the pass through which alone Samarkand could be approached from Afghanistan and the tribute which Timur was thus enabled to exact, and compared it with the 'Iron Gates' near Derbend, which controlled the trade from Persia and was also in Timur's hands. He referred to the entrance of the Oxus into the Caspian, though he himself did not visit this region. A Persian traveller of the period makes the same statement, but the question of the previous course of the Oxus is still unsettled.

#### April 27, 1896 —H. H. P. Deasy in Central Asia

Capt H. H. P. Deasy left Srnagar on the first of a series of expeditions which he continued until 1899. He explored part of the Upper Yarkand valley and a large area south of the Kuen Lun and east of Pagong Lake and Rudok, everywhere making careful surveys and thus doing much to fill in spaces previously blank on the map of Tibet.

#### April 28, 1806 —The Arctic Ice

Capt Scoresby, in the *Resolution*, an English whaling boat, entered the ice in  $76^{\circ}$  N, penetrating it by means of ice saws, and found the open sea beyond. He reached  $81^{\circ} 30'$  N in  $19^{\circ}$  E, the ice being fixed and solid to the north, with open sea to east-north-east and south-east. On board was Scoresby's seventeen-year-old son, William Scoresby, who took command of the *Resolution* in 1811. In 1813 he established the fact that the deep-sea temperature of the polar ocean is higher than the surface temperature. In 1822 he pushed his way through the ice floes that encumber the approach to the coast of east Greenland, and surveyed and charted 400 miles of that coast between  $69^{\circ} 30'$  and  $72^{\circ} 30'$  N. He later carried out researches on terrestrial magnetism, and in 1856 made a voyage to Australia to collect data on that subject. The work of the two Scoresbys threw new light on seasonal ice movements in the arctic.

### Societies and Academies

#### LONDON

Optical Society, March 10 —R. A. Houston. Absorption of light. The intensity of a beam of light at a point in an absorbing medium decreases exponentially as the distance travelled (Bouguer-Lambert law). It holds only for monochromatic radiation, and the ratio of the intensities at two given points is independent of the absolute intensity. This independence might be expected to break down when the intensity is very great, but experimental proof for this is surprisingly slight —E. Gifford. Note on refractive indices. A comparison between the refractive indices and dispersions of certain glasses is made with those of certain specified liquids.

Mineralogical Society, March 15 —F. A. Bannister. The distinction of pyrite from marcasite in nodular

growths. X-ray single crystal and powder photographs show that nodules from the Chalk in the south of England are pyrite. Examination of polished sections of a number of these nodules by reflected polarised light confirms this work, in no case of nodular pyrite yet examined is there evidence of an intimate intergrowth of marcasite and pyrite. Both methods have also been applied to the study of nodules from other localities, including the true marcasite nodules from Wisconsin, United States, and pyrite nodules in shales. Nodular pyrite is far more common than was formerly supposed, whereas nodular marcasite is comparatively rare —L. Hawkes and H. F. Harwood. On the changed composition of an anorthoclase-bearing rock-glass. The vitreous contact faces of a felsite dyke contains anorthoclase inlets which cannot have grown in a liquid represented by the glass. The glass, which shows no outward sign of alteration and exhibits strain birefringence, has taken up soda and water and lost potash and silica. Glasses are more liable to metasomatic change than crystalline rocks —A. E. Maurant. The spherulitic rhyolites of Jersey. The spherulites present a variety of structures. These are described and their origin is discussed, and particular attention is paid to rhythmic growth, of which there are good examples in some of the spherulites —Frederick Walker. An albitite from Ve Skerries, Shetland Isles. A specimen collected from this almost inaccessible group of rocks proves to consist of albite 90 per cent, chlorite (replacing biotite?) 2 per cent, quartz 2 per cent, with accessory titaniferous magnetite and apatite. Texture granitoid. Specific gravity 2.64. Chemical analysis compares closely with those of albitites from the Ural Mountains and from the Assynt district, Sutherland.

#### DUBLIN

Royal Dublin Society, Jan. 26 —Paul A. Murphy and R. McKay. The compound nature of crinkle and its production by means of a mixture of viruses. The naturally occurring potato virus disease known as crinkle is shown to be due to the presence of two viruses, the virus of simple mosaic and a new virus A. When simple mosaic is inoculated into healthy-looking plants of Irish Chieftain, which normally contain virus A, crinkle is produced, and the same result follows when the two constituent viruses are separately introduced into virus-free plants of other varieties. The synthetic disease appears to possess all the characteristics of natural crinkle. A mixture of streak and virus A also produces a form of crinkle, but this is shown to be due to a simple mosaic which generally accompanies streak. The latter has no part in the constitution of crinkle —Paul A. Murphy. A critical review of some recent work on the occurrence of virus complexes in the potato. The view that such naturally occurring virus diseases of the potato as crinkle, mosaic, and streak are compounds of the same X and Y viruses, as suggested by K. M. Smith, and are therefore closely related, has not been established. Differences are pointed out between the Y viruses derived from these three diseases, and explanations are offered to account for them. The Y virus obtained by analysis of streak in Up-to-Date is derivable in part from the simple mosaic which seems to accompany streak invariably, and probably in part from the streak element. Determination of the constitution of virus complexes by analysis is much more liable to error than determination by synthesis. The disease secured from crinkle in certain of Salaman's experiments is shown to have been simple mosaic, and not a reduced crinkle. The possible identity of crinkle and rugose mosaic is discussed.

## EDINBURGH

Royal Society, Feb 15 —J Walton and Jessie A R Wilson On the structure of *Vertebraria* During the latter part of the Palæozoic period the most abundant plant in the southern hemisphere was *Glossopteris* with its tongue-shaped leaves Along with these leaves, and, according to some workers, occasionally found attached to them, are peculiar stems A study of these stems (*Vertebraria*) shows that in structure they agree more with stems of seed plants than with ferns or any other group of plants Since *Glossopteris* has long been suspected of being a seed plant and not a fern, and in view of the supposed connexion between *Glossopteris* and *Vertebraria*, the structural evidence derived from *Vertebraria* is suggestive and is in favour of the supposed connexion between these two plant fossils —G Bond The effect of malnutrition on root structure An earlier investigator reported that decotylation results in an elimination of the pith from the part of the root afterwards formed in *Vicia* and *Phaseolus*, and further induces a reduction in the number of protoxylem rays in *Vicia* These statements have not been confirmed —Isobel M Case The development of the sorus in some species of *Nephrolepis*, together with some observations on points of anatomical interest Within the genus *Nephrolepis* the final position of the sorus varies considerably, from almost marginal to distinctly intramarginal types There is, however, no corresponding difference in point of origin of the sorus, this being in each case slightly superficial, the first sign of soral development being evident at a point five to six cells back from the marginal cell The vascular system of the stem is of an advanced dictyostelic nature The leaf trace is horse-shoe shaped, and consists of a number of separate strands The method of pinna-trace formation is marginal throughout the entire length of the frond —E Boyd The pigmentary system and the dopa reaction By the term 'pigmentary system' is meant the chromogen and a catalytic enzyme or enzymes, which by their interaction produce melanin in pigmented living tissues, and the cellular elements in those tissues which influence or are influenced by the reaction It is suggested that the pigment in differently coloured mammalian hair (reds, browns, and black, etc) is identical, the varying visible colours being the result of differences in physical structure or in deposition and disposition of the melanin in the fibre, while variations in the accomplished degree of oxidation of the basal chromogen may also influence the colour perceptible to the naked eye Evidence is produced to support the nuclear theory of the origin of melanin, in the finding of nuclear pigment caps in the epidermal cells of various breeds of sheep In sections from dominant white sheep no dopa-positive cells can be found in the Malpighian layer, in the fibre sheath, or in the hair bulb; sections from white sheep heterozygous for brown give a diffuse yellowish brown coloration with a few dopa-positive cells, in recessive browns a single layer of small dopa-positive cells is demonstrated in the Malpighian layer and there are other differences It may therefore be possible to evolve a quantitative test to enable a genotypic white to be distinguished from phenotypic white sheep

## COPENHAGEN

Royal Danish Academy of Science and Letters, Oct 30 —August Krogh Secretion of salt through the gills of fishes Processes involving the transport of dissolved substances against a head of pressure are, no doubt, of common occurrence in living organ-

isms, but only in a few cases is it possible to study such processes both qualitatively and quantitatively The experiments undertaken by A B Keys show that salts are given off from fish blood with  $\Delta = 0.6^\circ \text{C}$  through the gills to sea water ( $\Delta = 1.9^\circ \text{C}$ ) The mechanism and energetics of this process are discussed

Nov 27 —Harald Bohr Distribution of values of the zeta-function of Riemann

## CRACOW

Polish Academy of Arts and Letters, Nov 9 — Georges Bouligand Some applications of the theory of ensembles to infinitesimal geometry —L Chamard The Cantor-Minkowski construction —A Kordylewski Occultations of stars by the moon observed at Cracow 1923-30 —W Swietoslowski The application of the phenomenon of azeotropism to the determination of small quantities of impurities —W Swietoslowski and Mile J Szmigielska The determination of the proportion of water in alcohol and in the azeotropic carrier —Mile A Dorabalska, T Niwinski, and Mile E Turska The specific heats of some radioactive minerals Measurements with the adiabatic microcalorimeter —A Skapski and J Kamecki The influence of temperature on the trend of the electrocapillary curve —A Skapski The meaning of the action coefficient of neutral salts according to Szyszkowski, from the point of view of the modern theory of electrolytes —W Jacek The velocity of solution of marble in acids (2) —Mme W Solodkowska and Mile K Rudowska The determination of the heat developed in the course of the germination of seeds —K Dziewonski and A Kleszcz Studies in the fluorene series (4) Synthesis of 1,2-diacetofluorene —A Swaryczewski The crystallisation of ammonium chloride with cadmium chloride —M Ksiazkiewicz The tectonic of the southern part of the Cieszyn zone between the Olga and the Vistula —R Roslonski The value of the annual evaporation in the San basin —J Samsonowicz The supposed appearance of the Carboniferous in the west of Volhynia —Cz Kuzniar The geological structure of the potash deposits at Stebnik —W Domagalski The motor and separating tissues of the floral peduncles of *Spartmannia africana* —K Kaniewski The origin of new species in crosses between tetraploidal types of wheat —Mile J Siwakowna *Ancyrocephalus vistulensis*, a new trematode parasite of *Silurus glanis* —E Kryszczyński The absorption of the mineral compounds of the urine in the cloaca of birds

Jan 4 —S Dobinski The dielectric polarisation of solutions of sulphur in carbon disulphide —K Dziewonski and Sz Piasecki Researches on the oxidation of  $\alpha$ -acetoacensaphthene —K Dziewonski and J Schweiger The synthesis of ketones 2-propionylfluorene and 2,7-dipropionylfluorene —St Kozik Zinc diammino-bromide Crystallographic study —J S Ruszkowski The cycle of evolution of the cestode *Drepanidotenna lanceolata*

## GENEVA

Society of Physics and Natural History, Dec 3, 1931 —W H Schopfer (1) A new technique for preparing and mounting the zygotes of Mucorineae The author describes a technique for preserving, mounted in glycerol-gelatine on a microscope slide, all the strains of zygotes arising from a series of experiments —(2) A physiological separation of the phenomena of growth from those of sexuality in a fungus (*Phycomyces*) The author has made a series of experiments from which he concludes that conditions of culture exist which can inhibit sexuality in a non-

definitive and reversible manner, and this without interfering with vegetative development or inversely — M Grosjean and J J Pittard New methods and classification for the rapid determination of minerals The authors construct synoptic tables of minerals in which appear their essential physical properties, colour, hardness, density, fusibility, colour of the streak, and finally the principal chemical and crystallographic properties After a little practice, these tables allow of a rapid determination, by the application of the principle of dichotomic tables

Dec 17—A Liengme Contribution to the study of the human blood groups in hæmophilia From studies made on two families, the author concludes that, contrary to the view now generally held, the character for hæmophilia is not connected with the blood group —E Friedheim Pyocyanine and biological oxidations Pyocyanine, the blue pigment of the pyocyanic bacillus, represents a reversible system of oxidation-reduction Thanks to this property, this pigment has the function of a catalyst in the respiration of living cells such as the pyocyanic bacillus, staphylococcus, pneumococcus, red blood corpuscles of mammals, and cancer cells The increase of respiration observed reaches 2400 per cent —J and L Deshusses Some insects specially harmful to French-Swiss agriculture Besides parasites already known, the authors have recognised seven new species which, in their districts, attack celery, *cône*, fuchsia, apple tree, pear tree, certain varieties of peas, and hot-house plants

## MELBOURNE

Royal Society of Victoria, Nov 12 —Gerald F Hill Australian termites (Isoptera) Biological notes and new species This paper contains notes on the biology, distribution, and synonymy of several species of Australian *Calotermes*, *Coptotermes*, *Heterotermes*, and *Eutermes* Four new species, *Calotermes spoliator*, *Coptotermes tullyardi*, *Heterotermes intermedius*, and *Eutermes dixonii* are described —Bernard C Cotton and C J Gabriel Australian Unionidæ The authors comment on the difficulty of classifying the Australian forms, owing to the variability of the individuals which constitute a species and the tendency of one species to merge into another Ten species and a variety are enumerated, and two new genera, *Propehyridella* and *Protohyridella*, are suggested —A B Edwards The geology and petrology of Warburton This includes an acid suite of igneous rocks (rhyolites, dacites, and granodiorites) The igneous rocks intrude a series of Silurian sediments, and being contiguous with similar igneous rocks in the Blackspur area, are considered to be of Upper Devonian age The granodiorite is interesting on account of the presence of quartz nodules

## ROME

Royal National Academy of the Lincei, Dec 6 —G Fubini A theorem of Severi for analytic functions of two variables —E Bompiani Intersection invariants of two oblique curves —Enea Bortolotti Allied connexions associated with an  $(n+1)$ -pla of congruences in an  $n$ -dimensional variety —G Barba Metric transports —P Tortorici Maxima and minima of convex functions —Vladimiro Bernstein Ultra-convergence of certain series of Dirichlet (2) —L Godeaux An algebraic surface —M Kourensky The integration of equations which determine the conjugated functions of Beltrami —Maria Previatti Bortolozzi The equation of the asymptotic of a  $V_2$  with  $\sigma_2$  of three dimensions —Luigi Crocco A maximum value of the coefficient of heat-transmission by a plane lamina to a flowing fluid The ordinary theory of

heat transference between a plane lamina and a flowing fluid ignores entirely the influence of the heat developed by friction on the temperature gradient adjacent to the lamina and on the coefficient of transmission With high velocities this frictional heat is not negligible, and consideration of this case shows that the heat transference is governed by the law that holds when the frictional heat is negligible, provided that the temperature of the fluid is taken to be that to which it would be carried by adiabatic arrest —A Bellugi Further consideration of the gravimetric depressions in the Paduan valley —E Segrè Quadrupole lines in X-ray spectra All the known forbidden lines of X-ray spectra may be explained as quadrupole irradiation, which, in the case of X-ray spectra, is much greater than with optical spectra, and preponderates over all other causes for the appearance of forbidden lines It is, therefore, considered that the forbidden lines of X-rays are to be attributed to quadrupole transitions —L Mascarelli, D Gatti, and M Pirrona Contribution to the knowledge of diphenyl and its derivatives (10) Influence of certain substituents in the 2'-position on some reactions of  $\text{NH}_2$  in the 2-position —A Ferrari and C Colla Chemical and crystallographic investigations on complex nitrites (2) Double nitrites of potassium and nickel and of potassium and cobalt The compounds to which the formulæ  $6\text{KNO}_2$ ,  $3\text{Co}(\text{NO}_2)_2$ ,  $\text{H}_2\text{O}$  and  $2\text{KNO}_2$ ,  $\text{Co}(\text{NO}_2)_2$ ,  $\text{H}_2\text{O}$  have been attributed, are merely the cobaltinitrite contaminated with cobalt hydroxide This hydroxide is probably formed in the hydrolysis of the cobaltous nitrite, which gives also the nitrous acid causing the oxidation of the bi- to ter-valent cobalt and hence the formation of the cobaltinitrite The compound  $\text{K}_4\text{Ni}(\text{NO}_2)_6$  is monometric with a lattice of side  $a=10.49 \text{ \AA}$ , that of potassium cobaltinitrite is  $a=10.32 \pm 0.02 \text{ \AA}$  The close approximation between the values of the unit cell constants and the positions of the photogram lines for these two compounds indicate the existence between them of a close isomorphous relationship, in spite of the different numbers of atoms in the two molecules —L Sanzo Egg and first larval stages of *Myctophum Gemellari* Cocco (= *Scopelus Gemellari* C and V) —G Brunelli New contributions to the biology of lagoons —A Orrù Observations on the water-content of the white and yolk of hens' eggs during the development of the embryo During the incubation period, the white of hens' eggs undergoes gradual dehydration until the twelfth or thirteenth day, after which it increases in water-content continuously to almost the original value just before the shell breaks On the other hand, the yolk takes up water for twelve days and later suffers rapid dehydration, but not to such an extent as to bring the moisture content to the value it has in the quiescent egg —Ettore Marchiafava Obituary notice of Antonio Dionisi

## VIENNA

Academy of Sciences, Dec 17 —J Kissner, R Stasser, E Kiffe, and S Gollner Researches on bending due to wounds in dicotyledon seedlings and their material causes To one-sided injuries the seedlings react by bending, the reaction being greatest with stems in active growth A growth substance is formed in the end-buds of dicotyledon seedlings Removal of these end-buds inhibits growth, but growth is stimulated again on replacing the end-buds or by agar into which the growth-substance has diffused There appears to be also a wound-substance the action of which is contrary to that of the growth-substance —J Kissner and P Popp Growth and differentiation processes in dicotyledon

seedlings after continued removal of buds After removal of buds in *Helianthus* the leaves grew notably; this was due to growth in size of the leaf cells—J Kisser and M Lorenz Chemical stimulation of the germination of *Pisum* and *Triticum* under optimum germination conditions As stimulants the best were manganese salts and ethyl alcohol—J Kisser Critical remarks on the nature and the concept of seed germination—A Jagersberger Measurement of light transmission through cathode-sputtered silver films—L Schmid and R Falke Measurements of the viscosity of carbohydrates in liquid ammonia, in formamide and in water—A Kohler (1) Granite of type Eisgarn from the north-western Waldviertel (2) The monzonitic quartz-mica-diorite of Dornach in Upper Austria—H V Graber Comparative observations on the eruptive rocks of the circum-Adriatic arc—E Haberer Graptolites from the Upper Silurian of the Carnic Alps (2)—O Reithofer Report on the conclusion of the rift measurements in the wider neighbourhood of Kofels in the lower Oetz valley—O Sickenberg Geological researches in the northern Osterhorn group (Salzburg)

### Forthcoming Events

#### FRIDAY, APRIL 22

ROYAL ANTHROPOLOGICAL INSTITUTE (Human Biology Research Committee), at 5 30—Prof J B S Haldane Present Knowledge concerning Blood Groups  
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (Annual General Meeting) (at Waldorf Hotel, Aldwych), at 6 45, followed by dinner at 7 30—Sir Robert Horne Currency and Prices (Address)  
ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Prof J B S Haldane Hereditary Transmission of Acquired Characters

#### SATURDAY, APRIL 23

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin)—Prof J K Catterson-Smith Everyday Uses of Electricity (Faraday Lecture)

#### MONDAY, APRIL 25

ROYAL SOCIETY OF ARTS, at 8—Prof J C Drummond Recent Researches on the Nature and Function of Vitamins (Cantor Lectures) (2)

#### WEDNESDAY, APRIL 27

ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5—Annual General Meeting  
NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (simultaneously in London and New York) (at the Science Museum), at 5 30—W W Mason Trevithick's First Rail Locomotive—Hon Charles L Chandler Early Shipbuilding in Philadelphia  
LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at Museum, Leicester), at 7 30—Annual General Meeting  
ROYAL SOCIETY OF ARTS, at 8—H Ramsbotham Education for Commerce (Lecture).

#### THURSDAY, APRIL 28

ROYAL SOCIETY, at 4 30—Discussion The Structure of Atomic Nuclei To be opened by Lord Rutherford, followed by, probably, Dr J Chadwick, Dr C D Ellis, Prof R H Fowler, Prof J C McLennan, Prof F A Lindemann, and N F Mott  
INSTITUTION OF CIVIL ENGINEERS (Birmingham and District Association) (at Chamber of Commerce, Birmingham), at 6—Annual General Meeting  
AT B M A HOUSE (Tavistock Square)—Dr J H Sequeira

The Educational Aspect of Public Health Work in the Tropics (Chadwick Lecture)

#### FRIDAY, APRIL 29

ROYAL ASTRONOMICAL SOCIETY, at 4 30—Geophysical Discussion The Maintenance of the Earth's Electric Field To be opened by Dr F J W Whipple, and continued by Dr G C Simpson and others  
ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Prof H. Hartridge The Rival Theories of Hearing

### Official Publications Received

#### BRITISH

Proceedings of the Geologists' Association Edited by G S Sweeting Vol 43, Part 1, 30th March Pp 96 (London Edward Stanford, Ltd) 5s  
Thirty-second Report of the Felsted School Scientific Society, 1930-1931 Pp 42 (Felsted)  
Proceedings of the Linnean Society of London, Session 1931-32 Part 2 Containing Account of the Centenary Celebration of Robert Brown's Discovery of the Nucleus of the Vegetable Cell Pp 17 36 (London Linnean Society) 1s 6d  
Department of Agriculture New South Wales Science Bulletin No 38 The Control of Ked (Tick) in Sheep, including Report of Investigations by Dr H R Seddon and C Blumer Pp 28 (Sydney Alfred James Kent)  
Record of the Industrial Bursars of the Royal Commission for the Exhibition of 1851, 1911-1929 Pp 58 (London Royal Commission for the Exhibition of 1851)  
The Journal of the Royal Anthropological Institute of Great Britain and Ireland Vol 61, July to December 1931 Pp xii+287 519+18+45+plates 38-57 (London Francis Edwards) 15s net  
Quarterly Journal of the Royal Meteorological Society Vol 58, No 244, April Pp 89 216 (London Edward Stanford, Ltd) 7s 6d  
Proceedings of the Royal Society Series A, Vol 135, No A828, April 1 Pp 511 705+xx (London Harrison and Sons, Ltd) 12s 6d  
Annual Reports on the Progress of Chemistry for 1931 Issued by the Chemical Society Vol 28 Pp 448 (London Chemical Society) 10s 6d net  
Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society Edited by H Munro Fox Vol 7, No 2, April Pp 89 179 (Cambridge At the University Press) 12s 6d net  
Department of Scientific and Industrial Research Index to the Literature of Food Investigation Vol 3, No 2, September 1931 Compiled by Agnes Elisabeth Glennie Pp iv+183 (London H M Stationery Office) 2s 6d net  
Report of the Rugby School Natural History Society for the Year 1931 (Sixty fifth Issue) Pp 43 (Rugby George Over, Ltd)  
The Journal of the Institute of Metals Vol 47 Metallurgical Abstracts and Index to Volumes 45, 46 and 47 of the Journal Edited by G Shaw Scott Pp viii+854 (London Institute of Metals) 80s  
Annals of the Cape Observatory Vol 10 Spectroscopic Researches Part 9 The Spectrum of Nova Pictoris, 1925 By Dr H Spencer Jones Pp 532+6 plates (London H M Stationery Office) 50s net  
Observations made at the Royal Observatory, Greenwich, in the Year 1930, in Astronomy, Magnetism and Meteorology, under the direction of Sir Frank Dyson Pp vi+xi+102+39+Cix+C102+D64+10 plates+E48+17 (London H M Stationery Office) 37s 6d net  
Transactions of the Optical Society Vol 32, 1930-31, No 5 Pp ii+165-212+xx (London Optical Society) 10s

#### FOREIGN

Scientific Papers of the Institute of Physical and Chemical Research Nos 355 356 Über die Polymerisierung der Methylster höherer ungesättigter Fettsäuren, X Einfluss der Erhitzungstemperatur und des Zusatzes des Verdünnungsmittels, von Kichiro Kino, Chemische Untersuchungen in der Saponinreihe, Mitteilung 3 Über die Sapogenine von *Panax repens* Maxim und *Aralia chinensis*, L var, von Mumo Kotake und Yorisaburo Kimoto Pp 77-96+2 plates (Tōkyō Iwanami Shoten)  
U S Treasury Department Coast Guard Bulletin No 19 The Marion Expedition to Davis Strait and Baffin Bay under direction of the United States Coast Guard, 1923 Scientific Results, Part 1 The Bathymetry and Sediments of Davis Strait Pp vii+81 (Washington, D C Government Printing Office) 50 cents  
Ministry of Finance, Egypt Mines and Quarries Department Report on Boring for Oil in Egypt By Dr T Sutton Bowman Section 3 Eastern Desert and adjoining Islands (With Index to Sections 1, 2 and 3) Pp xvi+353+39 plates (Cairo Government Press) 30 P T  
Collection des travaux chimiques de Tchécoslovaquie Rédigée et publiée par E Votoček et J Heyrovsky Année 4, No 3, Mars Pp 97 144 (Prague Regia Societas Scientiarum Bohemica)  
Zoologica Scientific Contributions of the New York Zoological Society Vol 13, No 3 Bermuda Oceanographic Expeditions, 1931—Individual Nets and Data By William Beebe Pp 37 45 Vol 13, No 4 Nineteen New Species and Four Post-Larval Deep Sea Fish By William Beebe Pp 47 107 Vol 13, No 5 New Bermuda Fish, including Six New Species and Forty three Species hitherto unrecorded from Bermuda By William Beebe and John Tee Van Pp 109 120 (New York City)  
State of Illinois Department of Registration and Education Division of the Natural History Survey Forestry Circular No 5 Care of Trees By L E Sawyer Pp ii+7 (Urbana, Ill)  
U S Department of Agriculture Technical Bulletin No 275 The Biology and Control of the Blueberry Maggot in Washington County, Me By F H Lathrop and C B Nickels Pp 77+14 plates (Washington, D C Government Printing Office) 25 cents



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## Magic and Administration in Africa

IT is inevitable that the anthropologist should suffer a feeling of disillusion, almost at times mounting to the level of discouragement, when he looks back on the history of our official relations with 'native' races during the period of, say, the last fifty years. The lessons of his science, in his eyes plain so that he who runs may read, have been neglected time and again. Racial prejudices and tribal customs and beliefs have been flouted. Sometimes they have been ignored through lack of knowledge, sometimes deliberately set aside or suppressed. Even where there has been little or no overt resistance, tribal organisation has been weakened, with a consequent deterioration in the character of the people, but often acceptance of the decree of the European administration has been enforced only by a heavy expenditure of blood and treasure, of which both sides have had to bear the cost.

In many instances much that has proved detrimental to the subject race and a source of innumerable difficulties, and even of danger, to their rulers might have been avoided had the administration been inspired by the sympathetic understanding which would have followed from a scientific knowledge of the social and religious pattern in the everyday lives of those they governed. Individual officers have not necessarily been to blame. Usually without any scientific training in the study of backward peoples, many of them acquired empirically an adequate knowledge of native institutions, and at times, especially in India, their knowledge has probed deep into native ways of thought and action. Yet the whole trend of administration either attained no more than the preservation of law and order without any specific idea of direction, or at best aimed at the amelioration of the conditions of the native in accordance with European ideals. Customs out of harmony with, or repugnant to, these ideals, such as cannibalism, human sacrifice, or head-hunting, were sternly suppressed without thought of their place or meaning in tribal life, even as missionary influence discouraged or forbade polygamy and the bride-price in Africa without heed or knowledge of the inevitable disintegration of the tribal, social and economic system which was bound to ensue.

When the anthropologist, in urging the application of the results of anthropological science in practical affairs, deplors the suppression of custom in certain instances, it must by no means be taken that he approves these practices or advocates their

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preservation, however interesting or vital they may be for the academic study of man and the development of his institutions. It is their suppression without due regard to their function in the social organisation that he deplores. Head-hunting, for example, among certain peoples of Papua or in the Naga Hills of Assam, was of vital significance in tribal life. Suppression would have broken economic, social, and religious bonds in the community. A wise policy in administration, taking cognisance of the wide ramifications of the custom, retained the form of the institution, while securing the substitution of a pig or other animal for the human victim. A grasp of the essential function of the custom averted the disaster which would have followed its total suppression. The tribal organisation was saved from the danger of disintegration, and faith in the essential fair dealing of the administration was assured.

In Africa the problem of the attitude of the administration towards native custom is of the greatest moment on account of both the inherent difficulty of the question and the magnitude of the issues involved. A recent case of witchfinding in Kenya, to which reference is made in a well-informed article by Frank H. Melland which appeared in the *Times* of April 13, and subsequent letters from Lord Lugard and others in later issues, serves to illustrate the difference in outlook between white and black which lies at the root of the difficulties of a European administration in dealing with the native. The Kenya case has attracted considerable attention owing to the number of defendants involved, but it is only one of many similar with which the authorities in different parts of Africa have had to deal within the last few years. In this latest case, a witch was beaten to death with staves by the members of the tribe, after she had been smelled out by the witchfinder. This action was in accordance with tribal custom, but as a result sixty persons were arrested, put on trial for murder, and condemned to death at Nairobi.

From the strict point of view of the law, the proceedings at Nairobi were in order, and the sentence awarded a penalty in accordance with the law. Witchfinding is forbidden by law, and the punishment of a witch by death as the outcome of a witchfinding ceremony is technically murder. From the point of view of the native, however, the law of the European administration is both illogical and unjust. The fact that in this and other cases the sentence has been remitted or commuted to a term of imprisonment is irrelevant. Nor is it of any avail to attempt to meet the native with the argument

that the witchfinder is seeking something that does not exist. The majority of the natives of Africa hold firmly to the belief in the reality of magic. To them the evidence of innumerable happenings in everyday life bears out their assurance of its powers, and the deaths and other misfortunes of individuals are proof positive of the malevolent efficacy of the witch.

It is, of course, common knowledge among those familiar with the African, that magic enters deeply into his life, but how this belief and its relation to witchfinding reacts in unexpected directions and incidentally affects the relations with Europeans may be illustrated further by the difficulties which arose in the South African mines some twenty-five to thirty years ago. One of the elements which contributed very largely to the shortage of native labour then experienced in the mines was the fear of the magic which, in native conception, was the cause of the high death-rate, and the prohibition by the authorities of the 'throwing the bones' by means of which the magician who had caused the deaths in individual cases, was smelled out. It was their belief that death was caused solely by magical agency, and even now no members of the Bathonga tribes who leave their country to work in the mine and elsewhere are readmitted without an elaborate purification ceremony to remove the evil magic which clings to them and might bring death and pestilence to other members of the tribe.

Witchfinding, however, is only one of the various means by which the native seeks to protect, not himself alone, but also the whole of his group from the influence of evil magic. To forbid witchfinding and to inflict the death penalty on those who meted out the customary retribution on the witch—in the eyes of the tribe a murderer and worse—is as irrational a proceeding in the eyes of the native as it would be Gilbertian in a civilised community if the detective who tracked down a criminal, and the court that inflicted punishment, thereby became liable to the extreme penalty of the law.

It might be thought that in course of time knowledge of the penalty inflicted by the law will have its effect and the employment of witchfinders die out. This is improbable, at least within a reasonable time, for more reasons than one. The example of what happened in England is instructive in this connexion. Even in the middle of the eighteenth century, a hundred years after the Essex witchfinder Hopkins had been discredited and long after witchcraft as such had ceased to be recognised in law, certain individuals caused the death of a suspected witch by the ducking test, and were convicted



of murder As both Lord Lugard and Mr Melland point out, the situation in regard to witchcraft in Africa calls for an alteration in the law Unless, moreover, the law recognises the African point of view, no measure is likely to provide a solution However much it may be repugnant to European ideas, and whether magic be regarded as an illusion or not, the African's belief in magic must at least be accepted as a reality

The acceptance of witchcraft and magic as something more than futile superstition which may be disregarded or swept aside goes deeper than a mere concession to the native's failure as yet to grasp the facts of existence as the European sees them Nor should such beliefs be treated lightly if, as is conceivable, cases of suspected witchcraft were made the subject of inquiry, instead of being left, as they are now, as a matter purely of concern to the native, unless they result in some action which brings him within reach of the European's law In present conditions, the only element in the witchcraft superstition of which the administration takes cognisance is the witchfinding and the execution of the witch—the very means whereby the native gives expression to the solidarity of the group, and tribal society acts in self-preservation against an anti-social force

Tribal solidarity, and with it tribal discipline and the authority of the chief, are being assailed on many sides by the rapid changes now taking place in Africa Since the War, the increased facilities for transport have made the native more mobile He goes far afield to find employment and in increasing numbers He earns money as an individual, whereas formerly his earnings were the property of his group With this individual wealth at his disposal for furnishing the bride-price, no longer in many cases payable in cattle, he marries without reference to his family or tribal group, and often when he returns home he is a wealthier man than his chief

What may be the effect in the modification of native institutions of these varied influences brought into play by the impact of white civilisation is now being made the subject of a much-needed inquiry by the International Institute of African Languages The African is being hurried from his status of merely a component part in a unitary group, the family or tribe, into that of an individual independent of traditional ties, before he has had an opportunity of learning the responsibilities of the individual Administrative action which in any way hastens this process prematurely may precipitate disaster

### Forests and Forestry

- (1) *An Outline of Forest Pathology* By Prof Ernest E Hubert Pp viii+543 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1931 ) 30s net
- (2) *Seeding and Planting in the Practice of Forestry a Manual for the Guidance of Forestry Students, Foresters, Nurserymen, Forest Owners, and Farmers* By Prof James W Toumey Second edition revised and enlarged by Prof Clarence F Korstian Pp xviii+507 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1931 ) 25s net
- (3) *Histoire des bois et forêts de Belgique* Par le Comte Goblet d'Alviella (Des origines à la fin du régime autrichien, Tome 4 ) Pp 448+23 planches (Paris Paul Lechevalier , Bruxelles Maurice Lamertin, 1930 )
- (4) *A Handbook of Coniferae including Gnkoaceae* By W Dallimore and A Bruce Jackson Second edition Pp xiv+582+32 plates (London Edward Arnold and Co , 1931 ) 42s net
- (5) *Ökologie des Waldes mit besonderer Berücksichtigung des deutschen Wirtschaftswaldes ein Lehr- und Handbuch für Naturwissenschaftler* Von Prof Dr Alfred Dengler Pp vi+272+2 Tafeln (Berlin Julius Springer, 1930 ) 25 gold marks

(1) **T**HE author of this book requires no introduction to those who have followed his work on the decay of timber As may be expected in a book written by a professor of the University of Idaho, forest pathology is dealt with almost entirely from the point of view of North America, but as the causes of disease and decay, and the control measures necessary, are largely common to other regions, the book should be of interest to foresters generally

The book is divided into three parts Part 1 (introductory) contains a classification of tree diseases, and deals with the factors influencing disease, the relative importance of tree diseases, economic losses, and symptoms of disease and decay Part 2, which bears the title "Forest Pathology", deals with various forms of injury, such as that caused by frost, drought, insolation, smoke, and other agencies, and describes certain specific diseases, it concludes with a short account of control methods Part 3, headed "Wood Pathology", deals with the decay of timber, both converted and unconverted

The book has a practical outlook, and the fungi

most effectively dealt with are those of special economic importance, for which reason it should prove of service more particularly to the practical man. It is well illustrated, and contains useful references to literature at the end of each section.

(2) This is a second edition of Prof Toumey's "Seeding and Planting in the Practice of Forestry" (1916), revised and enlarged by Prof Korstian. In general arrangement the book follows the first edition fairly closely, and is divided into two main parts, the first dealing briefly with the silvicultural basis of regeneration (including methods of reproduction, choice of species, spacing, and the composition of the crop), and the second and by far the larger part dealing with the formation of forests by seeding (sowing) and planting. This part goes in considerable detail into the technique of artificial regeneration, including the collection, extraction, storage, and testing of seed, the preparation of planting sites, the establishment of plantations by direct sowing and transplanting, and nursery practice.

In some respects the new edition is more definitely an American textbook than the original one, since most of the additions refer to American practice, nevertheless, it should prove of much value to British foresters, even though some of the methods described are scarcely applicable to British conditions, while some of the methods practised in Great Britain are not dealt with. It is interesting to note that more use is made of horse-drawn implements in American than in British forest nurseries. There are useful references to bibliography at the end of each chapter, the illustrations are good, and the book is attractively got up.

(3) Three volumes of the Comte Goblet d'Alviella's "Histoire des bois et forêts de Belgique" have already appeared. The present volume deals with communal and private forests in the Netherlands during the seventeenth and eighteenth centuries, and is in a sense supplementary to vols 2 and 3, which deal with State forests during the same period. This period is important in showing a sudden transition from the old feudal system, which had an intimate bearing on the forest, to a new regime brought about by legislation which democratised it. This radical political change, although it inaugurated an era inimical to the forest, did not effect an immediate transformation in methods of silviculture and management, since here, as elsewhere, economic rather than political considerations had a deciding effect on the production, and thus on the conservation and treatment, of the forests.

Under the old regime, forestry was dominated by the demand for (1) oak timber for construction, agricultural purposes, and shipbuilding, and (2) charcoal for the metallurgical industry, which had been much developed since the sixteenth century and required material of moderate size in large quantities. The system best adapted to meet these requirements was coppice with standards, and hence it was the one almost exclusively employed. In spite of political changes it continued long after the end of the old regime, although there were drastic administrative changes in the direction of centralised control. The author's aim has been to give a comprehensive view of the development of forestry during the period in question without entering into minute details, and he has produced an authoritative work which will be of much interest to foresters and historians alike.

(4) The first edition of Dallimore and Jackson's valuable "Handbook of Coniferae" appeared in 1923. In the present edition the opportunity has been taken to include in an appendix descriptions of a number of species, varieties, and hybrids omitted in the first edition, together with short descriptions of the more important new species brought to light in recent years chiefly as the result of exploration in China and elsewhere. Another innovation is the inclusion of a list of synonyms, giving the correct botanical names under the Vienna rules, of a number of species, of which the names in common use among arboriculturists are retained in the text. Thus, to take a few examples, *Abies pectinata* DC becomes *A. alba* Miller, *Araucaria imbricata* Pav becomes *A. araucana* K Koch, *Larix europæa* DC becomes *L. decidua* Mill, and *P. Laricio* Poir becomes *P. nigra* Arn. The use of generic instead of family headings on the right-hand pages is a definite improvement. This book is likely to retain its value as a standard work on conifers, and none interested in this subject can afford to dispense with it. If there is one suggestion that might be made, it is that in the next edition the opportunity might be taken to revise the keys.

(5) Prof Dengler's "Ökologie des Waldes" is a separate issue of Part 1 of his larger work, "Waldbau auf ökologischer Grundlage", of which Part 2 deals with silvicultural technique. As the title denotes, the ecology of woods is taken as the basis of silviculture. The first section deals with the forest as a vegetation type, considers its relationship to other types of vegetation, and gives a brief account of forest types throughout the world, from tropical to polar and alpine regions. This is followed by a

more detailed account of the natural distribution in Europe and Western Asia of the principal German trees and the development, prehistoric and historical, of German forests. This section concludes with an account of the present distribution of forests in Germany, with their chief component species.

The second section contains a discussion of climatic and edaphic factors in relation to tree growth, and touches on the question of local races. A summary is given of the results of work on forest soils carried out in recent years by various investigators. An interesting diagram, based on the work of Hartmann, shows the range of hydrogen ion concentration of a number of common herbaceous and shrubby forest plants: this demonstrates, for example, the intolerance to acid conditions of *Geranium Robertianum*, *Brachypodium sylvaticum*, and *Dactylis glomerata*, the acid tolerance of *Vaccinium Myrtillus* and *V. Vitis idæa*, and the wide range of tolerance of *Hypnum Schreberi* and *H. purum*. A short account of the physiological life-history of the forest completes the volume.

The scope of this work is mainly limited to German conditions, and the literature cited is almost entirely that of German-speaking countries; nevertheless, the book should prove of value to students of the fundamental principles of silviculture in other countries.

### The Geological Age of *Pithecanthropus*

*The Age of Pithecanthropus*. By Dr. Ir. L. J. C. van Es. Pp. xii + 142 + 4 plates. (The Hague: Martinus Nijhoff, 1931.) 8 guilders.

LITTLE is known about the exact geological age of the oldest fossil human remains hitherto discovered, and every contribution to the subject is welcome. The age especially of the most primitive ancestral man, *Pithecanthropus*, found by Prof. Dubois in a river deposit in Java, has already been much discussed without any definite conclusion. We are, therefore, glad to receive a most valuable small volume on the Tertiary geology of Java by Dr. L. J. C. van Es, who seems to prove that this remarkable fossil dates back to the Lower Pleistocene period. Dr. van Es bases his work on the researches of Prof. E. Dubois, K. Martin, and G. A. F. Molengraaff, to whom he dedicates his publication. He has studied thoroughly the geology of Java, and he illustrates his description by a series of sections and maps, which have been prepared with the help of the Chief of the Geological Survey of the Netherlands Indies.

Since the beginning of the Upper Miocene period at least, there has always been much volcanic activity in the region of Java, and extensive volcanic breccias and tuffs are associated with the deposits containing corals and marine shells, up to those of the Middle Pliocene. They then occur also with lake and river deposits of Upper Pliocene, Pleistocene, and more recent date. There have indeed been many alterations in the level of the land and sea, and there seems to have been a connexion with the Asiatic continent, through Sumatra, in the Upper Pliocene, when land mammals, such as the primitive elephants *Mastodon* and *Stegodon*, *Hippopotamus* and *Cervus*, first invaded Java. The successive marine deposits which now form part of the land are marked by an increasing percentage of existing species of shells among the fossils, as might be expected. It is thus possible to identify them even when they are not seen directly superposed.

The river deposit at Trinil, in which *Pithecanthropus* was discovered, rests unconformably on a marine formation, which is shown by its fossils to be of Middle Pliocene age. The gap in the geological series indicated by the unconformity is filled in other districts by marine deposits, which contain 66-70 per cent of existing species of shells and are therefore Upper Pliocene. Hence the conclusion, that if a marine formation equivalent in age to the Trinil river deposit were found, it would contain more than seventy per cent of existing species of shells and must be regarded as Pleistocene. The percentage of existing species of freshwater shells in the Trinil deposit itself supports this conclusion, and as the associated land mammals (*Stegodon*, *Hippopotamus*, etc.) are much like those in the Lower Pleistocene Nerbada river deposits of India, *Pithecanthropus* evidently dates back to the beginning of the Pleistocene period. A. S. W.

### Nature and Man in Arabia

*Arabia Felix Across the Empty Quarter of Arabia*. By Bertram Thomas. With a Foreword by T. E. Lawrence and Appendix by Sir Arthur Keith. Pp. xxix + 397 + 48 plates. (London and Toronto: Jonathan Cape, 1932.) 25s. net.

THIS book embodies so many important contributions to the common stock of scientific knowledge that the reader marvels that one man should have been able, within the period of twelve months, unaided by public funds or private beneficence, to accomplish so much. Mr. Bertram Thomas, who crossed the great empty quarter of

Arabia, an area hitherto wholly unknown, as great as France and Germany combined, just a year ago, approached his task in a purely scientific spirit, after years of patient preparation. Having learned on board H.M.'s ships to fix his position by the stars, he has produced an excellent map, full of topographical and other details, which would do credit to a trained survey party. He was at pains to measure heads with callipers, and to describe systematically the features of the tribes he encountered, hitherto wholly unrecorded, and in a valuable appendix Sir Arthur Keith and Dr Krogman discuss the anthropological material he has amassed, on which they place a high value. Mr Thomas collected everything he saw, and preserved his specimens so effectively that Dr Calman and his colleagues at South Kensington, who have contributed another lengthy and valuable section, have been able to describe a baker's dozen of specimens new to science, and very many hitherto unrecorded in Arabia.

The geological results are meagre—due to the unpromising uniformity of the formations traversed, but include a meteorite and a valuable series of specimens of rocks and sands, with an analysis of the water in a score or more of wells along the route traversed.

Perhaps, however, the most important contribution to science is the author's description of 'singing sands'. Lord Curzon, in his "Tales of Travels", published in 1923, brought together all known sources of information on the subject, but records nothing so circumstantial as Mr Thomas's experience.

"We were floundering", he writes, "through heavy dunes when the silence was suddenly broken by a loud droning on a musical note. I was startled for the moment, not knowing the cause."

"The hour was 4.15 P.M., and a slight north wind blew from the rear of the cliff."

"Before this, in similar winds, we had passed many such cliffs, but they had emitted no sound, only the light surface sand being carried up the gentle windward slope to spill like smoke over its top. The leeward face of the cliff was a fairly steep slanting wall, and I looked in vain for a more funnel-shaped sand gorge that by some rushing wind action might account for so great a volume of noise. The usual term 'singing sands' seems to me hardly appropriate to describe a sound indistinguishable from the siren of a moderate-sized steamship. The noise continued for about two minutes and, like a ship's fog-signal, ended as abruptly as it had begun."

This description raises very interesting issues. The question was first scientifically discussed by No 3261, Vol. 129]

C. Carus Wilson,<sup>1</sup> who ascribed the phenomenon to "the rubbing together of the surfaces of millions of perfectly clean grains of quartz, free from angularities, roughness, or adherent matter, investing the grains", he adds that, "though the vibrations emitted by the friction of any two grains might be inaudible, those issuing from millions approximately of the same size would give an audible note."

Two American experts, Drs Bolton and Juhen, on the other hand, claimed<sup>2</sup> that—

"The true cause of the sonorous property is connected with thin pellicles or films of air or of gases thence derived, deposited, and condensed upon the surface of the sand-grains during gradual evaporation, after wetting by the sea, lakes, or rains. By virtue of these films the sand-grains become separated by elastic cushions of condensed gases, capable of considerable vibration. The extent of the vibration and the amount and tone of the sound thereby produced, after any quick disturbance of the sand, is largely dependent upon the forms, structures, and surfaces of the sand-grains, and especially upon their purity or freedom from fine silt or dust."

This explanation postulates some degree of previous moisture, induced or exhausted by evaporation. It is tenable in relation to beaches, but not to dunes.

Poynting and Thomson, on the other hand ("Sound"), offer the following explanation:

"There is an arrangement of minimum volume for a number of equal spheres in contact. We may suppose the sand to consist of equal spheres arranged, when undisturbed, so as to occupy minimum volume. When disturbed the mass may pass through many successive minima of volume before coming to rest, and if we can suppose the time occupied in passing from one minimum to the next is constant, a musical note should issue."

None of these explanations seems to cover the production of sound like a ship's siren, and it appears more probable that electrical phenomena may be involved.

These, and many other matters of interest, such as tribal customs, exorcism, marriage, birth and death, clothing and food, the dietetic value of raw gastric juices of camels and gazelles, invest the book with high scientific interest and eugenic significance.

It remains to say that the book is finely written, illustrated by a wealth of photographs which show the author to be no less competent with his camera than with pen, and adorned with a wealth of stories which go to prove that the inhabitants of this part

of Arabia, both male and female, are freer than we are from the bonds of convention in some vital matters, such as sexual relations and taboos, though still in bondage in other directions to ghostly fears and the terror of the unknown

A T W.

<sup>1</sup> NATURE, 44, 322, 1891

<sup>2</sup> Trans N Y Acad Sci, 8, 10, 10, 28, 1890

### Universities of the British Empire

*The Yearbook of the Universities of the Empire, 1932* Edited by Sir H Frank Heath Published for the Universities Bureau of the British Empire Pp xiv+953 (London G Bell and Sons, Ltd, 1932) 15s net

BEFORE 1914 the only general directory of the staffs of the British universities was in the German yearbook of the learned world, "Minerva" It was in 1912 that the late Sir George Parkin, then organising secretary of the Rhodes Trust, urged upon the members of the first congress of the universities of the British Empire that they ought to arrange for the setting up of a central office charged with the duty, among others, of producing a yearbook The idea found acceptance and the "Universities Yearbook" has now become a valuable aid to intercourse in the sphere of science and higher education between the countries belonging to the British Commonwealth of nations

The main concern of the 1932 issue of this "Yearbook", as of its predecessors, is to provide, (1) in respect of each of the universities (seventy in number), a directory of its administrative staff and the professors and lecturers, etc, in each of its fields of study, a description of its material equipment, organisation, conditions of graduation, etc, and a summary of events of the past year, (2) a general account of the universities of each national group in their relationship to one another and to the national system of education, (3) particulars of open post-graduate scholarships, etc, and of centres of scientific research and scientific information

An interesting new feature of this year's issue is a short bibliography giving particulars of books dealing with the British universities and with facilities for study abroad, but not including (as it well might) references to important articles that appeared during the past year in periodicals The chapter on the Australian universities has been rewritten and brought up to date by Prof J T Wilson, professor of anatomy at the University of Cambridge and formerly Challis professor of anatomy at Sydney. The result is not such an intriguing story as the Canadian chapter (revised

for the 1931 issue), but all these university group surveys, including those for the British Isles, South Africa, and India, are eminently readable essays whether taken singly or together

The very useful appendix describing centres of scientific research and information, for the most part not directly connected with universities, has been expanded and now covers fifty-five pages Like other annual publications, the "Yearbook" exhibits a tendency to increase in bulk with advancing years, but, thanks to improvements in arrangement and indexing, this has not had the effect of making the search for any particular item of information more difficult Succinct and lucid, it is fit to take a place in any collection of quick reference books dealing with the cultural life of the English-speaking world

### Short Reviews

*Reports of the Progress of Applied Chemistry* Issued by the Society of Chemical Industry Vol 16, 1931 Pp 748 (London Society of Chemical Industry, 1932)

"Bis dat qui cito dat" is a true saying, which applies to no publications more forcibly than to annual reports Again the report on the progress of applied chemistry, as comprehensive and as invaluable as ever, has been published early in the year following that reviewed The contents are as follows general, plant, and machinery (R E V Hampson and J N Vowler), fuel (J G King); gas, carbonisation, tar, and tar products (H Hollings and W A Voss), mineral oils (A W Nash and A R Bowen), colouring matters and dyes (L J Hooley), fibres, textiles, cellulose, and paper (V E Yarsley), bleaching, dyeing, printing, and finishing (P E King), acids, alkalis, and salts (A Proven), glass (M Parkin), refractories, ceramics, and cements (J H Chesters and W J Rees), iron and steel (A L Norbury and F K Neath), non-ferrous metals (A R Powell), electrochemical and electrometallurgical industries (H T S Britton and R A Robinson), oils, fats, and waxes (E R Bolton and K A Williams), paints, pigments, varnishes, and resins (G C Attfield, S Marks, L R Hickson, and W Singleton), rubber (T R Dawson), leather and glue (W R Atkin), soils and fertilisers (E M Crowther), sugars, starches, and gums (J P Ogilvie), fermentation industries (H Li Hind and F E Day), foods (G D Elsdon), sanitation and water purification (A Parker), fine chemicals, medicinal substances, and essential oils (E Stedman), photographic materials and processes (A Batley and E E Jelley) The participation of members of the staffs of official organisations—H M Fuel Research Station, the British Launderers' Research Association, the British Cast Iron Research Association, the Research Association of British Rubber Manufacturers, and the Water Pollution Research section

of the Department of Scientific and Industrial Research—is noted with satisfaction

Only too frequently is it necessary to refer to the effect of the industrial depression on activity in the chemical industries, but the degree to which the flow of new knowledge has been maintained is a factor of great significance for the future. Already many definite improvements in the situation as it affects those industries are recorded. Among many matters of general interest referred to are the collapse of the price and production agreement between the Chilean and synthetic nitrogen interests and the operation of a price-fixing agreement reached between the Russian, Columbian, Canadian, and South African producers of platinum

A A E

*A Descriptive Petrography of the Igneous Rocks*  
By Prof. A. Johannsen. Vol. 1. *Introduction, Textures, Classifications and Glossary*. Pp. xxii + 267. (Chicago. University of Chicago Press, London. Cambridge University Press, 1931) 21s net

In this first volume the author provides an introduction to the science of petrography. After dealing with the constituents (minerals), and their relations (textures), he gives in summary some twenty-five systems of classification of the igneous rocks. As many of these are now of historical interest only, he rightly pays more attention to those of present practical importance. Thus the systems of Osann and Niggli, the American normative system, and the author's own, which the second volume will fully illustrate, have each a chapter devoted to them, whilst those of Rosenbusch, Zirkel, and Shand are adequately described. Most of them are illustrated by examples, and as the same rock analysis is used in several, a very fair comparison may be made. No formal criticism of the different methods is ventured upon. Two admirable glossaries of mineralogical and textural terms with sundry tables and two indexes complete the volume.

The book is well printed and illustrated, the selection and reproduction of the photomicrographs illustrating textures are all that could be desired. An interesting feature is the inclusion of photographs, with short biographies, of the authors of the more important classifications. Throughout the work abundant references to original sources are made, and the text is enriched with many quotations. It is pleasing to note that where the author has been unable to check a reference it is starred. The errata noted are exceedingly few, on p. 130, quantitative has been used for qualitative, and on p. 157 Orders 1 and 2 should be 1 and 4.

The classification advocated by the author is based on the mineral composition of the rocks as determined in thin slices. Four classes are recognised from the relative proportions of light and dark coloured constituents, division into orders depends on the character of the plagioclase present, whilst further subdivision into families and sub-families is determined by the proportions of quartz or felspathoids, or the ratio of potash felspar to

plagioclase. Certain new terms and names, built on the 'portmanteau' method, are suggested. The full exposition in the second volume will be awaited with interest.

*A Monograph of the Recent Cephalopoda based on the Collections in the British Museum (Natural History)*. Part 2. *The Octopoda (excluding the Octopodinae)*. By G. C. Robson. Pp. xi + 359 + 6 plates. (London. British Museum (Natural History), 1932) 20s

THIS work gathers into one volume practically all the available knowledge of the Octopoda (exclusive of *Octopus* and some allied genera monographed in Part 1 in 1929), and includes a great deal of new information due to the author's comprehensive studies of these animals, not only in the British Museum, but also in Paris, Monaco, Berlin, Leyden, and elsewhere. Our knowledge of the whole group is definitely advanced, so that it is now possible to review the systematic interrelationships of the Octopoda with some confidence.

Apart from the Palæoctopoda, based on *Palæoctopus*, the only known fossil octopod, which has been re-examined and yields fresh evidence, three suborders are recognised, the Vampyromorpha, which are the least specialised and apparently most archaic group, the Cirromorpha (*Cirroteuthis*, *Opisthoteuthis*, etc.), and the Incirrata. This last group includes forms more familiar to the general naturalist, such as *Argonauta*, *Octopus*, and *Eledone*. The species commonly associated under *Eledone* prove to be a polyphyletic group now distributed among Octopodidae and Bathypolypodidae.

The chapter on "Classification and Evolution" is of special interest, and considerable ingenuity is shown in distinguishing resemblances due to convergence from those due to relationship. In some places the general discussion is a little vague, but definite results are reached in most of the major problems. The systematic part, which occupies about three-quarters of the volume, is throughout excellent, and, so far as we have been able to test it, wholly trustworthy.

*Health and Social Evolution* (Halley Stewart Lectures, 1930) By Sir George Newman. Pp. 200. (London. George Allen and Unwin, Ltd., 1931) 4s 6d net

THIS comprehensive review of the health of the people, and the gradual recognition of public health as an aim of State activity, shows the hand of a master throughout. Beginning with the Middle Ages, which saw the horrors of the Black Death, and also the beginnings of anatomy and physiology, the author goes on to describe the medical and the humanitarian contributions of the eighteenth century, and the effects upon public health of the industrial revolution, political and social reform, and the growth of State intervention in the field of public health as in other fields. The present position of the State medical service in relation to infant and maternal mortality, the health of the school child, the health insurance services, and the international health



services is then dealt with. Finally the author asks: What are the gains and the losses in national health? Some of the gains are obvious, but there are failures and losses also: failure to get ignorant people to recognise quackery, and loss in average fitness through success in saving feeble infants of the type that used to contribute to the infant mortality rate. Here, as the author implies, we come upon a problem which has its moral as well as its medical aspect.

*Common Pests: how to Control some of the Pests that affect Man's Health, Happiness and Welfare* By Rennie W. Doane. Pp viii + 397. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas, London: Baillière, Tindall and Cox, 1931.) 21s net.

THIS book sets out to be a handy manual for the farmer, stockman, gardener, and the householder. Being intended for American readers, it deals exclusively with American pests, and much of the information given is of little value to readers outside the United States. It contains many Americanisms, and descends at times to a childishness which is extremely irritating. Little is left to the intelligence of the reader, for example, on p. 119, the author, referring to the use of hydrocyanic acid gas, remarks: "As this gas is deadly to all animal life, rats, mice, and all kinds of insects will be destroyed. Any cats, birds, or other household pets left in the house while the fumigating is being done will, of course, suffer the same fate."

The field which the author has attempted to cover is too large to admit of satisfactory treatment, and the ambitiousness of the project defeats its own ends. Spiders, mites, insects, parasitic worms, birds, and mammals are all included. In many cases the descriptions are too meagre to be of use to any but the specialist, and much of the matter is unintelligible to any but the scientific reader. Nevertheless, a vast amount of interesting information is given, much of it very useful to those for whom it is intended, particularly in the chapters on insecticides and the control of insect pests. The matter is well arranged and convenient for reference, and the book is profusely illustrated.

J. O. C.

*Applied Personnel Administration* By J. E. Walters. Pp ix + 338. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 18s 6d net.

ALL human affairs seem to be in process of reorganisation, notably the industrial situation. The contrast between the inter-relationship of master and man to-day and prior to the year 1832 is marked. Formerly, the employee was normally regarded as a mere producing factor, without human interest to the employer. A pioneer in humanisation was Robert Owen, who not only pointed, but also led, the way on the path of Christian socialism in industrial affairs. Sir Walter Besant's later efforts in the same direction met with a practical response in the People's Palace which Mr. Beaumont established in Mile End,

but this, unfortunately, became side-tracked. The United States, as Mr. J. E. Walters shows in this well-arranged and comprehensive book, has gone steadily forward on lines of industrial progress, and though some may consider that there is an excess of officialdom and of official methods, yet the practical outcome of the movement has been beneficial, not to employees and employers alone, but also to the public at large. It may well be that the swing of the pendulum has been excessive, and that a certain tendency towards over-guidance and over-control has resulted; this may, however, presently swing slightly backward, whereby individual self-dependence will be better established.

P. L. M.

*The History of the Maya from the Earliest Times to the Present Day* By Thomas Gann and J. Eric Thompson. Pp x + 264 (26 plates). (London: Charles Scribner's Sons, 1931.) 8s 6d.

THIS brief history of the Mayas should do much in helping to stimulate interest in the archaeology of Central America. Notwithstanding the fact that one British and several American expeditions are now at work each season on Central American sites, very little interest is taken in the results by the English public. Yet the work of these expeditions is adding rapidly to our knowledge of a remarkable civilisation, of which the problems are as fascinating as they have proved baffling. The authors of this little book have not attempted to discuss controversial matters, nor have they aimed at a detailed description of the sites. They give a historical outline of Maya history as revealed by the most recent discoveries of the earliest and latest dates of occupation of the Maya settlements, and sketch briefly the main features of Maya art, industry, daily life, and religion. The book, in fact, contains in readable form exactly the information which will give the background essential for the appreciation of the character and bearing of the discoveries now being made by scientific exploration.

*Social Organisation and Ceremonial Institutions of the Bomvana* By P. A. W. Cook. Pp xi + 171 + 16 plates. (Cape Town and Johannesburg: Juta and Co., Ltd., n.d.) 10s 6d.

THE Bomvana are a Bantu people of the Transkei who, according to their own tradition, are derived from the Amanguema, a people said to have lived in Natal. It is probable that it was somewhere about the middle of the sixteenth century that they were driven out of Natal and settled among the Pondos, with whom they remained until the beginning of the nineteenth century. It is evident that although all call themselves Bomvana, the tribe is composite. Mr. Cook has made a very thorough study of their social organisation, religion, and ritual. While their institutions generally conform to type, it is indicated very clearly that, speaking broadly, no generalisation about the Bantu peoples of South Africa is sound. Each must be studied individually. This warning is not unnecessary, even for anthropologists, and still less for the administration.

## Young, Champollion, and Hieroglyphics

By Dr ALLAN FERGUSON

IT is a seemly thing to "praise famous men renowned for their power, giving counsel by their understanding . . . who were honoured in their generation, and were the glory of their times", but it is well, even in a centenary notice, to be strictly accurate in assigning priority. Champollion accomplished great and lasting work for Egyptology, but it is not correct to describe him as the man "who first deciphered the hieroglyphics" (NATURE, p 307, Feb 27, 1932). The phrase implies a rounded-off and complete contribution to knowledge such as is seldom made by any pioneer, and was certainly not made by Champollion. He did notable work in the deciphering of hieroglyphics, but he owed much to the labours of at least one of his predecessors, and unfortunately was not at all ready to acknowledge the help which such work had afforded him.

To-day it is not a question for discussion—it is a matter of fact that the first successful steps towards the solution of the problem of hieroglyphics were due to the genius of Thomas Young, and it is demonstrable that Champollion had not realised the correct mode of attack on the problem until Young's discoveries pointed out the way.

Young's is an arresting character—he crowded into his fifty-six years of life (1773–1829) more and more varied discoveries than seems possible for any one man, however greatly gifted. His work in optics, in the theory of surface forces, and in the science of Egyptology is in the first rank. Less important, but illustrating his amazing versatility, are his contributions to medical science and to the theory of the tides, his articles on subjects so diverse as life assurance, bridges, carpentry, and pendular oscillations. His gifts of scholarship are well exhibited in recorded notes of conversations with London scholars—notes which show that, at the age of eighteen, he could argue questions of criticism and emendation, on not unequal terms, with the great Porson himself.

The study of the development of genius is always interesting, and never more so than in the case of Young.\* In spite of the immensity and variety of his learning, the amount of his reading was not very large, but "he adhered strictly through life to the principle of doing nothing by halves. Whatever book he had begun to read, he read completely and deliberately through, whatever study he commenced, he never abandoned, and it was by steadily adhering to this principle . . . that he was accustomed to attribute in after life a great part of his success, both as a scholar and as a man of science."

It is noteworthy that he took small account of any gifts of inspiration of genius, laying weight

rather on concentration and on an accurate knowledge of, and attention to, matters of detail. This last-named power is shown in his exquisite Greek script—calligraphy in the literal sense of the term—and its application as a weapon of research cannot be better exhibited than in his copies of the Rosetta stone inscriptions and in his laborious piecing together of their texts.

The story of the Rosetta stone has not been told so often as to have lost its interest, and in view of Champollion's centenary, may bear retelling.

It was in 1799 that the stone was unearthed by a French engineer engaged in digging the foundations of a fort in the neighbourhood of Rosetta, a small Egyptian town some miles north-east of Alexandria and situated on an arm of the Nile near its mouth. With many other antiquities it was handed over to the English after the capitulation of Alexandria, and was deposited in the British Museum in February 1802. It is a slab of black basalt 11 inches thick, and in surface dimensions is now about 3 feet 9 inches by 2 feet 4½ inches, but it has lost large fragments from the upper corners and from the right-hand bottom corner. In its un mutilated state it was probably 5 or 6 feet high. It carries three inscriptions, written in two languages. The uppermost inscription is written in the sacred character, the middle in the cursive demotic character, and both these inscriptions are in the Egyptian language. The third and lowermost inscription is written in the Greek language and in Greek uncial characters.

It follows from the manner in which the stone has been mutilated that the hieroglyphic text has suffered most. The demotic text contains 32 lines, 14 being imperfect at the beginnings, the Greek text contains 54 lines, 26 being mutilated at the ends, the hieroglyphic text contains some 14 lines, about half of the text having disappeared.

In the year 196 B.C., there was a general assembly of Egyptian priests held at Memphis to commemorate the accession of Ptolemy V. By reason of the benefits that Ptolemy had conferred upon the land—benefits which included gifts to the temples, remission of taxes, the administration of justice, abolition of the press-gang for the navy, and the founding of temples—the priests assembled in council decreed that certain specified additional honours should be paid to him and to his ancestors, and they further ordained that the decree should be inscribed upon "a stele of hard stone in the writing of the words of the gods, and the writing of books, and the writing of the lords of the North, and it shall be made to stand in the sanctuaries in the temples . . . near the statue of the King of the North and South, Ptolemy, living for ever, beloved of Ptah, the God who maketh himself manifest, whose deeds are beautiful."

\* Peacock, "Life of Young", Leitch, "Young's Miscellaneous Works" (3 vols.), E. A. Wallis Budge, "First Steps in Egyptian", E. A. Wallis Budge, "The Decrees of Memphis and Canopus" (3 vols.)

This, then, is the import of the inscriptions on the famous stone

Egyptian writing exists in three forms—hieroglyphic, the sacred picture-writing, hieratic, a simplified form of hieroglyphics, and demotic, an abbreviated form of hieratic writing. We have to remember, in order to realise fully the difficulties that faced the pioneers in this work, that a hieroglyphic symbol may be an ideograph, or may represent a sound, and in the latter case it may represent either a syllable or a letter. The difficulties of elucidation are further emphasised by the existence of determinatives, or signs which help to represent the meanings of words written with the aid of alphabetic or syllabic symbols. Thus, to take a very simple example, the word for *obelisk* (tekhen) may be written by drawing the picture of an obelisk, or, if, however, we write the word by means of the alphabetic symbols t, kh, n, we make assurance doubly sure by following this by a picture of an obelisk, used as a determinative.

The Greek text was early deciphered, and a conjectural restoration of the ends of the mutilated lines was made by Porson. The Oriental scholars, Silvestre de Sacy and Akerblad, worked at the demotic text with some small measure of success, but the first seriously successful attack on the Egyptian inscriptions was made by Young. So early as 1814, Young had made translations of these texts, and in his "Account of some recent Discoveries in Hieroglyphical Literature and Egyptian Antiquities", published in 1823, he enumerates some nine of his early deductions—that simple objects are represented by their actual delineations, and that many signs are used in a figurative sense, he gives the signs for the dual and the plural, for units and for tens, the rule for the direction in which hieroglyphics must be read, remarks that the name of Ptolemy alone existed on the Rosetta stone, and that proper names are included in an oval ring.

This account of his early work was published in 1823 and, in a disputed question of priority, needs careful and critical comparison with the earlier dated publications, we have now, however, to chronicle the publication of a work which, without the slightest possibility of cavil, establishes Young's priority in this region of research. This is the article on "Egypt", originally published in 1819 in the supplement to the "Encyclopædia Britannica". In the plates which accompany this article he prints a word list, and, most important of all, gives a list of alphabetic and syllabic characters. Out of thirteen signs, six are correct, three partly correct, and four wrong. This article, as Sir E. A. Wallis Budge remarks, "is practically the foundation of the science of Egyptology, because it contains a list of a number of alphabetical Egyptian characters to which, in most cases, he had assigned correct value. In other words, the idea of a phonetic principle in the reading of hieroglyphics, which had been but dimly comprehended by Warburton, De Guignes, Barthélemy, and Zoega, was clearly grasped by Dr. Young, and was accurately applied by him FOR THE FIRST TIME in the history of the decipher-

ment of the Egyptian hieroglyphic. As Chabas rightly expressed it, 'Cette idée fut, dans la réalité, le *fiat lux* de la science'."

Now let us briefly consider the claims of Champollion (1790–1832) to be described as the first decipherer of the hieroglyphics. Devoted as he was to classical and Oriental studies from an early age, he accumulated a mass of knowledge which, in this field, far surpassed that of Young. In 1812 he was appointed professor of ancient history at Grenoble, and in 1821 he published his treatise, "De l'écriture hiératique des anciens Égyptiens". In the course of this work he states unambiguously that hieratic writing is not alphabetic, that it is a simple modification of the hieroglyphic system, differing therefrom merely in the form of the signs, that it must be considered as hieroglyphic tachygraphy, and that *hieratic characters are signs of things and not signs of sounds*.

It is obvious, therefore, that despite Young's publication of 1819, Champollion, in 1821, was convinced that there was no trace of an alphabet in the hieroglyphic and hieratic characters. In 1822 all is changed. Champollion now publishes his famous "Lettre à M. Dacier, relative à l'alphabet des hiéroglyphes phonétiques employés par les Égyptiens pour inscrire sur leurs monuments les titres, les noms et les surnoms des souverains grecs et romains", in which the alphabetic character of many of the symbols is clearly defined and an alphabet published. As we have seen, Young had already published an alphabet based on an analysis of the names Ptolemy and Berenice. Moreover, it should be noted that Bankes had identified *as a whole* the set of signs which make up the name of Cleopatra. With the letters obtained from Ptolemy and Berenice as a guide, it becomes a matter of cryptogram analysis to find the meaning of the unidentified symbols in the signature of Cleopatra, and with every further extension to a new name the process becomes more easy and more certain.

What is to be assigned as the cause of the remarkable change in the opinions of Champollion? Peacock states categorically that Champollion endeavoured to suppress his unfortunately expressed work of 1821, it is certain that he sent the illustrations of the work to Young without the letterpress—a method admirably adapted to obscure the date of publication—and it is difficult to give any reason, at all creditable to Champollion, for his persistent misstatements concerning the relation of Young's researches to his own.

The probability is that Champollion, who must, before 1821, have become acquainted with Young's Egypt article of 1819, had not appreciated its full significance, more especially as some of its results are stated by Young in a characteristically diffident fashion. If we assume that Champollion realised the full meaning of Young's great advance only after he had published his work of 1821, the matter seems tolerably clear.

However this may be, it is certain that Champollion's contributions to the elucidation of hieroglyphics, great as they were, and carried as they

were to a point which Young could never hope to reach, were posterior to, and probably determined by, Young's fundamental contribution

"In a lapidary inscription a man is not upon oath," said Johnson. That is very true, and the great mass of such inscriptions may be permitted an affectionate exaggeration of the qualities of the departed. But when we read on the tablet in-

scribed to Young's memory in Westminster Abbey a eulogium of Young as one who "alike eminent in almost every department of human learning, patient of unintermitted labour, endowed with the faculty of intuitive perception" first penetrated the obscurity which had veiled for ages the Hieroglyphics of Egypt", we are reading no more than the literal and unadorned truth

### Oil and Petrol from Coal\*

By Prof C. H. LANDER, CBE

ALL fuels consist essentially of carbon and hydrogen combined in different proportions. In oil, the proportion of hydrogen to carbon is higher than in coal; further, oil contains less oxygen than coal. It is thus obvious that in order to turn coal into oil the proportions of carbon, hydrogen, and oxygen must be suitably readjusted. Various ways of doing this have suggested themselves to the scientific mind, but oil was first produced commercially from coal almost, as it were, accidentally, for it is one of the by-products in the manufacture of gas from coal.

Gas is made by the destructive distillation of coal, usually termed carbonisation. In this process, the coal is heated to a high temperature in closed retorts, the gas and condensable vapours which are driven off are collected, and from the resulting liquid products a certain quantity of oil can be prepared. In the course of these reactions there is a redistribution of the carbon and hydrogen atoms, the coke, which is left behind in the retort, consists mainly of carbon, and has a lower proportion of hydrogen than the original coal, while the liquid and gaseous products have a higher proportion of hydrogen than the original coal.

If the carbonisation is carried out at a lower temperature, say at a dull red heat instead of the bright white heat associated with normal gas-making processes, the yield of gas is less and the yields of coke and liquid products greater, while the latter are more nearly akin to natural petroleum. This process is usually known as low-temperature carbonisation.

Since light spirit is at the present time far more valuable than heavy oils, there have been introduced methods of again redistributing the molecules in the liquid products from the carbonisation of coal, so as to obtain higher yields of the lighter spirit. During this process, which is known as cracking, a residue, which has been deprived of hydrogen, appears as coke. Cracking is also widely applied to the heavier fractions obtained in the distillation of petrol from natural oils.

In obtaining petrol directly from the carbonisation of coal, low temperature carbonisation, cracking pushed to its limits, and the scrubbing of the gas to recover further small quantities of light spirit have not up to the present been able to raise

the total yield of motor spirit beyond 6-7 gallons per ton of raw coal. It must, however, not be forgotten that the primary object of carbonisation processes is the manufacture of coke and gas, and that light spirit, valuable as it may be per gallon, is still only a by-product.

The enormous importance of oil and petrol in modern civilisation has naturally focused attention on the possibilities of reshuffling the molecules in the coal in a way favourable to greater oil production, but, as I have already pointed out, coal, as compared with oil, is deficient in hydrogen. The possibility therefore suggests itself of adding extra

| CARBON | H <sub>2</sub> O, NH <sub>3</sub> ,<br>H <sub>2</sub> S |                  |            |
|--------|---------------------------------------------------------|------------------|------------|
|        | H <sub>2</sub>                                          | H <sub>2</sub> S |            |
| 95     | 5                                                       | 12               | COAL       |
| 93     | 7                                                       | 5                | HEAVY OIL  |
| 91     | 9                                                       | 3                | MIDDLE OIL |
| 88     | 12                                                      |                  | PETROL     |

FIG 1

hydrogen to the coal substance in order to make up this deficiency, and then, by some means or other, inducing the molecules of the mixture to reshuffle themselves into oil molecules. This has actually been accomplished, and for this success due credit must be paid to the work of Dr Friedrich Bergius, at Mannheim, who was the first to liquefy coal by direct hydrogenation.

Important and striking developments of the hydrogenation process as applied to coal have been made during the past six years, in Great Britain mainly by the Fuel Research Board and Imperial Chemical Industries, Ltd. Fig 1 † shows how the oxygen, nitrogen, and sulphur in the coal are removed as water, ammonia, and sulphuretted hydrogen. The residual hydrocarbons in the coal (95 per cent C, 5 per cent H) break down and combine with hydrogen to give a large percentage of petrol (88 per cent C, 12 per cent H), the solid material probably passing through heavy oil (93 per cent C, 7 per cent H) and middle oil (91 per cent C, 9 per cent H). It will be seen that although at present

\* From the Friday evening discourse at the Royal Institution delivered on Nov 20, 1931.

† For this and the other illustrations selected from the original discourse for publication here, thanks are due to Imperial Chemical Industries, Ltd.

petrol forms the most attractive product on account of its comparatively high price, the process could be stopped at an intermediate stage and so made to yield kerosene, diesel oil, or fuel oil

So important to the interests of Great Britain did the possibilities of the hydrogenation of coal appear that active work was inaugurated at the Fuel Research Station in 1922, with results so encouraging that in 1926 an intermediate-scale continuous plant, on the lines of Bergius' latest development, was set up at the Fuel Research Station, and, largely through the foresight of Dr W. R. Ormandy, who had organised a syndicate to explore the possibility of applying the Bergius process to British coal, an agreement was entered into between the British Government and Dr Bergius for the pooling and mutual discussion of the results obtained in both laboratories

#### BERGIUS PROCESS

The Bergius process consists essentially in subjecting coal to the action of hydrogen at a high temperature and a high pressure. The powdered coal is prepared for treatment by mixing it with a small quantity of alkaline iron oxide (luxmasse), which acts as a catalyst, and a suitable oil or tar, which may be a fraction of the liquid product obtained from previous runs

For the preliminary exploration of the process on a small scale, converters consisting of steel-walled vessels, closed by means of a blank flange, and of capacity about 2 litres, are used. A spindle projects from each end of the closed converter so that it can be carried on bearings and rotated over a row of gas flames. The pressure is measured by means of a gauge attached to one of the spindles through which there is drilled a passage to the interior of the vessel, and the temperature is measured by a thermocouple contained within a closed tube carried by the cover and projecting into the converter along its axis

In hydrogenating coal by the original Bergius process, a thoroughly well-mixed paste is made from 20 parts of coal, 1 part of iron oxide (luxmasse), and 8 parts of oil, the oil being taken from some of the heavier fractions obtained from previous runs. This paste is inserted into the converter, which is then closed. Hydrogen is pumped into the converter until a pressure of about 100 atm is reached, when the converter is placed in its bearings and rotated over the gas flames, the temperature being raised to about 450° C, while the pressure at the same time rises to about 200 atm. The reaction is allowed to proceed for two hours, after which the converter is cooled and the products extracted

In these discontinuous experiments it is possible to use coal either in the dry powdered state or in a paste. In a continuous plant, however, there would be great difficulty in injecting a solid material in powdered form into an enclosure which is already under a high gaseous (hydrogen) pressure. By mixing the fine coal with oil into a paste a material is obtained which can be pumped, and this

expedient formed one of the most important claims in the Bergius patents

In the small continuous Bergius plant, capable of dealing with about one ton a day, installed at the Fuel Research Station, the product is a relatively mobile oil, and the rough balance-sheet of the process shows that 50 per cent of the coal is transformed into distillable oil, 20 per cent into gas, and about 15 per cent remains as partially converted material. Some of the partially converted solids remain in suspension in a very fine state in the crude hydrogenated product, and make it very difficult to distil, but by taking proper precautions a series of fractions can be obtained. The heavier fractions can be rehydrogenated for the production of a further quantity of light spirit

#### FUEL RESEARCH STATION MODIFIED PROCESS

Further experimental work was carried out at the Fuel Research Station in order to increase the yield of the lighter fractions at the expense of the heavier oils, and to examine the process in the absence of a complicating factor such as a liquid vehicle for converting the coal into a paste. Improved catalysts were used, and the work was carried out in two stages. In the first stage, coal mixed with a suitable catalyst was heated under pressure in a stream of hydrogen. The reaction products were carried over by the hydrogen and through a second catalyst, in which further conversion to motor spirit took place in the gaseous phase. Experiments have been carried out using 50 lb of clean coal, and a yield of 140 gal of motor spirit was obtained per ton of dry, ash-free coal. The net hydrogen required amounted to 8.8 per cent by weight of the coal, giving, together with the 5.6 per cent already present, a total of 14.4 per cent of hydrogen required for the reactions

The yields of the different products obtained in the processes of high and low temperature carbonisation and a hydrogenation process are shown in the accompanying table

YIELDS FROM BITUMINOUS COALS SUBMITTED TO DIFFERENT TREATMENTS

|                                     | Carbonisation    |                 | Hydrogenation (Fuel Research Station) |
|-------------------------------------|------------------|-----------------|---------------------------------------|
|                                     | High temperature | Low temperature |                                       |
| Motor spirit                        | 1.1              | 1.1             | 45.1                                  |
| Diesel oil and creosote oil         | 2.1              | 3.4             | 4.4                                   |
| Fuel oil                            | 0.5              |                 |                                       |
| Lubricating oil                     |                  | 0.5             |                                       |
| Pitch                               | 2.4              | 4.4             |                                       |
| Ammonia                             | 0.2              | 0.1             | 0.5                                   |
| Water                               | 6.3              | 5.3             | 6.8                                   |
| Gas                                 | 10.0             | 15.8            | 30.4                                  |
| Organic matter insoluble in benzene |                  |                 | 7.8                                   |
| Coke                                | 63.4             | 64.4            |                                       |
| Ash                                 | 5.0              | 5.0             | 5.0                                   |
| Total                               | 100.0            |                 |                                       |

(To be continued)

### York Meeting of the British Association

THE British Association, after celebrating its centenary in London last year, will return this year appropriately to its birthplace, York. The annual meeting will be held there on Aug 31–Sept 7, and the preliminary programme has just been issued. The reception room will be in the Exhibition Buildings. The inaugural meeting and evening lectures will be given in the adjoining exhibition hall, a structure which, when it served the same purpose for Ramsay, Huxley, and Spottiswoode at the jubilee meeting in 1881, was labelled as ‘temporary’, but through various vicissitudes has stood the test of time, and now has been amply restored since its service as a post-office sorting-shed.

Under the new arrangement of the period of the presidency, Sir Alfred Ewing has already assumed that office for the present year, and the subject of his presidential address is now announced as “An Engineer’s Outlook”. Many other topics of wide interest are already set down for addresses, lectures, or discussions—some of them are even intriguing. Thus a pleasing anticipation cannot but supervene when, reading on from the title of the presidential address, the eye is held by that of Prof Miles Walker’s address to Section G (Engineering)—“The Call to the Engineer to Manage the World”. Again, those who have wisely fostered co-operation between the sections should be no less satisfied than interested by the announcement of a joint meeting between Sections A (Mathematical and Physical Sciences) and J (Psychology) to discuss the quantitative relation of physical stimuli and sensory events.

Among the sectional presidents, Prof A O Rankine’s address to Section A will deal with physics in prospecting for minerals. Stereo-chemistry will be an important topic in Section B (Chemistry), as the presidential address by Dr W H Mills will deal with it, and it will also be the subject of a discussion. Prof P G H Boswell, undertaking an onerous double duty in presiding over Section C (Geology) while also a general secretary of the Association, will give his address on “The Contacts of Geology: The Ice Age and Man”, and this section also announces a joint discussion with Section H (Anthropology) on geology and prehistoric archaeology. Primates and early man will be considered by Sections D (Zoology) and H (Anthropology). The subject of Lord Rothschild’s address to Section D is not yet announced. Prof H J Fleure will address Section E (Geography) on the geographical study of society and world problems, Prof R B Forrester, Section F (Economics), on Britain’s access to overseas markets, Dr Randall MacIver, Section H (Anthropology) on the place of archaeology as a science, Prof Beatrice Edgell, Section J (Psychology) on current constructive theories in psychology, and Prof J H Priestley, Section K (Botany), on “The Growing Tree”. The department of forestry under

the last section will hear an address from Mr T B Ponsonby on a system of forestry for the British Isles. The Association, through the work of committees and otherwise, has long striven to foster the advancement of science in schools. This will be the subject of Mr W M Heller’s address to Section I (Education), and, it is understood, may be also discussed at a special evening meeting. Prof R G White’s address to Section M (Agriculture) will deal with sheep farming. It may be added here that Section I (Physiology) will not meet in view of the simultaneous meeting of the International Physiological Congress in Rome.

Among other subjects, the interests of York, Yorkshire, and north-eastern England will rightly find a prominent place. The chemists will discuss water pollution with special reference to the present investigations in the River Tees. The relation of the millstone grit to the carboniferous limestone, the gravels of the Wolds margin, and the concealed coalfield of East Yorkshire appear in the geological programme. Section E announces a series of communications on local physical, historical, and industrial geography, and Roman archaeology will appropriately receive close consideration in Section H. The university movement and adult education in Yorkshire will be discussed in the educational section. Lastly, in so important a railway centre as York, the home also of a railway museum (which will be visited), it is fitting that Section G (Engineering) will consider railway traction by steam, oil engine, and electric power.

Evening discourses will be given by Sir Arthur Hill on plant products of the British Empire in relation to human needs, and by Mr C C Paterson on uses of the photoelectric cell, while Mr H E Wimperis will give an afternoon lecture, not for members exclusively, on high speed flying.

An evening reception will be given by the Lord Mayor of York (Alderman Vernon Wragge) and the Sheriff (Mr Arnold Rowntree). Many points of interest in the neighbourhood of York (and none is richer in them) will be visited. The Yorkshire Philosophical Society, mother society of the Association, will welcome its well-grown daughter by throwing open its museum and gardens to members daily throughout the meeting. The museum itself, scene of the first meeting of the Association in 1831, and headquarters of its organisation under John Phillips, will now house Section D (Zoology) in its more modern Tempest Anderson hall.

Local officers and a committee in York already have the local arrangements fully in hand, including the important question of housing visitors. In this connexion, it is impossible to resist a quotation from the announcement of the first meeting, in 1831. Therein it was provided that on the first day of the meeting “the Managing Committee will receive, at the Museum, the names of Persons intending to be present, and will deliver tickets for the Morning and Evening Meetings, and Dinners, and references



for Lodgings The Committee will think it right to pay regard to economy, as well as convenience, in these arrangements" Without doubt the present local committee shares this aspiration, but members will not fail to take cognisance of a footnote to the above announcement, which appears in the

Report for 1831 "On Tuesday a public dinner was provided at Twelve Shillings a Ticket, on the other days, during the session, ordinaries at from Five to Seven Shillings a head venison, game, and fruit being contributed" In this respect at least there need be no fear that history will repeat itself

### Obituary

M GUILLAUME BIGOURDAN

THE death of M Bigourdan has taken from us a veteran astronomer, well known to many of his English colleagues He attended the meeting of the Paris Academy of Sciences on Feb 22, in his usual health, but died suddenly on Feb 28 Born at Sistels (Tarn-et-Garonne) on April 6, 1851, M Bigourdan graduated in the École d'Astronomie in Paris, and was in 1877 appointed by M Tisserand as an assistant in the Observatory at Toulouse Here he was employed on meridian astronomy and devoted his leisure to historical studies in astronomy, which interested him all his life

In 1879, M Bigourdan was appointed assistant at the Paris Observatory and had charge of the large equatorial Here he spent many years in the most assiduous observations of the positions of nebulae and clusters In this very trying work he determined the positions of the known nebulae with all the precision possible from visual observations, discovered many new ones, and incidentally made measures of comets and double stars The intention underlying these arduous observations was to provide such accurate positions of the nebulae that future astronomers might detect small movements in these very distant objects The results were published in the *Annales* of the Paris Observatory, and have since been collected in five large volumes, consisting of about three thousand pages The gold medal of the Royal Astronomical Society was awarded to M Bigourdan in 1919 for this monumental work

Owing to differences between French and English observers in the values for the longitude of Paris, a re-determination was made in 1902 by M Bigourdan and M Lancelin working simultaneously with Sir Frank Dyson and Mr Hollis The results were in satisfactory accordance, and the mean differs by only 0.01<sup>s</sup> from the recent

determination made by 'wireless' transmission of time-signals M Bigourdan was from its commencement interested in the transmission of time by wireless, which is due to so great an extent to the initiative of General Ferrié When Paris became the centre of the international time service, he was, until 1928, director of the Bureau

In 1882, M Bigourdan took part in the observations of the transit of Venus in Martinique, and he was a member of eclipse expeditions to Senegal in 1892, to Spain in 1900, and to Tunis in 1905 He was for many years a member of the Bureau des Longitudes, and enriched many volumes of the *Annuaire* by articles on astronomical topics His most important work on the history of astronomy was the bringing out of the "*Annales célestes du dix-septième siècle*" by A G Pingré This work was completed in manuscript in 1791 and a beginning made of its publication This went on slowly until the death of Pingré and then ceased The manuscript was lost, but was found by M Bigourdan under a wrong designation in the Paris Observatory It was printed in 1901 under the auspices of the Academy of Sciences

M Bigourdan was courteous and affable, and always put his point of view with vigour and vivacity An incident which took place at the meeting of the International Astronomical Union at Rome in 1922 may be recalled The discussion was bilingual One of the British delegates spoke in French, which his British colleagues all understood Whether M Bigourdan had not been listening, or whether he wished maliciously to indicate that the French was not perfect, I do not know, but he amused his British colleagues by calling out "Traduction"

He married a daughter of Admiral Mouchez, and they had nine children, to whom we would offer our respectful sympathy F W DYSON.

### News and Views

#### Oliver Heaviside's Work

At a meeting of the Institution of Electrical Engineers on April 21, Dr W E Sumpner gave the annual Kelvin Lecture, choosing as his subject the work of Oliver Heaviside Before the lecture, the Faraday medal, the highest honour the Institution can give, was presented to Sir Oliver Lodge Dr Sumpner said that the work of Heaviside blended telegraphy, the earliest activity of electrical engineers, with radio communication, their latest activity The older electricians were in the habit of applying Kelvin's formulæ, which apply only to submarine cables, to telephony Heaviside's idea of increasing the self-

induction of the line was diametrically opposed to the prevailing practice The whole industry was in the hands of a government department very properly reluctant to try expensive experiments Heaviside's mathematics were not easy to understand and wanted laborious study even by professed mathematicians This was why some of his theories, although suggested several years before they were practically tried in France and America, were never actually put to the test in Great Britain His 'distortionless' circuit enabled signals to be transmitted at high speed in submarine cables and made telephony through long cables possible His work on the cable problem did

a great deal more than lead to the theory of the 'loading coil'. It showed that ordinary telegraphy was only a special form of directed wave telegraphy. Heaviside was the first radio-telegraphist. His analysis of Maxwell's theory was of the orthodox type, but when he dealt with the cable problem, he threw over all the conventional methods used by mathematicians.

#### The Mellon Institute at Pittsburgh

THE nineteenth Annual Report of the director, Dr E R Weidlen, to the trustees of Mellon Institute of Industrial Research, Pittsburgh, Pa., with which the name of Mr Andrew Mellon, the new U S Ambassador in London, is associated, has recently been issued. It appears that the sum of 722,541 dollars was received by the institution from industrial fellowship donors during the fiscal year ended Feb 29, 1932, bringing the total for the past 21 years to 8,277,018 dollars. Throughout the past year 75 industrial fellowships, employing 176 scientific workers and engineers, were in operation. At the close of the year, 58 fellowships were active, and of these, 28 have been at work for five years or longer and 13 have concluded more than ten years of research. Since 1911, when the industrial fellowship system was established at the University of Pittsburgh, Mellon Institute has had fellowships on 230 distinct subjects, on which 775 workers have been engaged, and 313 fellows and 357 fellowship assistants, having completed their services, have entered the fields of industry and education. As trained additions to the forces of manufacturing and teaching, these men constitute the Institute's greatest contribution to humanity. The constructional work on the Institute's new building is proceeding satisfactorily, it is thought that this edifice will be completed and ready for occupancy in the summer of 1933.

#### Testing Work for the Building Industry

IN recent years there has been a growing demand on the Building Research Station of the Department of Scientific and Industrial Research for tests and reports on building materials and forms of construction. In order to enable the Station to cope with these requests, a panel of approved testing laboratories is being established to act in association with the Station. The essence of the scheme is to put the Station in the position to have tests carried out at laboratories on the panel and then to incorporate the results in Government reports or certificates issued by the Station. The bulk of the tests will probably be mechanical or physical, of the chemical tests, most will probably be simple analyses. Applications are invited from testing laboratories wishing to participate in the scheme. Further particulars and forms of application can be obtained from the Director, Building Research Station, Garston, Herts.

#### Building Research

WE have received the Report of the Building Research Board for the year 1930 (London H M Stationery Office 2s 6d net), which is a document of 136 pages with an index. The report deals with a

number of important aspects of building materials and construction. In a section on damp walls it is pointed out that it does not seem possible to guarantee that a solid brick or masonry wall will exclude damp under all conditions, but no instance has been recorded of the failure of a properly constructed cavity wall to exclude damp. Experiments on noise in buildings showed that where the weight of material necessary to obtain sound insulation is excessive, a considerable reduction of noise can be obtained by the use of composite structures with air spaces between the component parts. The efflorescences on brickwork, due to soluble salts in the bricks, mortar, or external sources, are best removed by washing by hand when the amount of soluble salts is limited. The preparation of standard specifications for building materials is receiving special attention by the Board in conjunction with the British Standards Institution, and it is highly satisfactory to note that a considerable measure of co-operation between the Building Research Station and industry has been achieved. The report also refers to a considerable amount of work on concrete and reinforced concrete which has been carried out, and a new laboratory is being erected to house this work. The report shows that a very useful purpose is being fulfilled by the Board, the activities of which may be expected to increase in several directions as time goes on.

#### Agricultural Parasites Research in Canada

INTERNAL parasites are one of the stock-farmer's biggest problems all over the British Empire. They are the poultry-farmer's worst enemy, and, in all probability, constitute the most severe check on the growth of the poultry industry in the British Isles. In Canada it has been estimated that parasitic infestation causes an annual loss of £4,000,000 and is responsible for the death of one-tenth of the Dominion's live stock. A new Empire centre for the scientific study of internal parasites has been established in Canada, with the assistance of a grant from the Empire Marketing Board. New buildings, which will house the Institute of Parasitology, are now being erected by the Quebec Government at Macdonald College, the agricultural college attached to McGill University. The scheme is being financed for three years jointly by the Empire Marketing Board and the National Research Council of Canada. It marks the first occasion on which the Canadian Government and the Empire Marketing Board have combined to support a joint scheme of research. It is hoped that the new Institute may eventually become an Empire headquarters for the study of internal parasites, somewhat as Onderstepoort, in South Africa, has become recognised as an Empire centre for animal diseases research. The scheme therefore provides a fresh example of Empire team-work in the field of agricultural research.

#### Change-Over from Direct to Alternating Current

AT the present time electricians are interested in the problem of the change-over from direct current to alternating current systems of supply. Where new systems are being laid down in Great Britain the

three-phase, four-wire alternating current system of supply is being taken as the standard, the pressure of supply from the three outers to the neutral main being 230 volts. There is still a large number of supply stations in Great Britain which do not use the standard system, and if they are to reap the benefits of standardisation they must change to a c. In a paper by H. Blades and A. C. MacQueen, read to the Institution of Electrical Engineers on March 31, this change-over is discussed. They show that the problems arising in dealing with small towns and suburban and residential districts are different from those arising in industrial and city areas. In the former areas the change-over from d c systems to a c systems should take place at the earliest possible opportunity. As the life of a c low pressure cables is, as a rule, about twice as long as that of d c cables, the costs for renewals would be considerably diminished. Some eight years ago a supply undertaking replaced a large section of its direct current network with very satisfactory results. The total cost of the change-over was cheaper than the estimated cost of replacing the old d c system and the maintenance and development charges were appreciably reduced. The faults which frequently occurred in the mains when direct current was used now practically never occur. The best methods of carrying out the change-over are given in the paper, and the necessary arrangements that have to be made with the consumers explained. As the number of consumers who have radio receivers actuated from the mains is rapidly increasing, the change-over costs to the supply companies increases concurrently, and this in addition to the engineering and technical reasons makes an early change from d c to a c advisable. In industrial and city areas the best rate at which the change-over should occur depends on the demand and the condition of the direct current plant.

#### Clocks Worked from the Electric Supply Mains

WHEN a house is supplied with alternating current electricity on the time-controlled system, it is possible to use an electric clock which keeps almost exact Greenwich time, the error being at the most only a few seconds per week. The principle used in their working is that of the synchronous motor, which keeps in exact step with the frequency of the alternating current, and the frequency is controlled by a 'master controller' regulated by Greenwich time so as to make it easy to synchronise the generators connected with the network. The clocks cost from thirty shillings upwards, depending on the size and design of the case used. The first synchronous clocks were used in the United States about twelve years ago, and, from their inventor, were called Warren clocks. In America more than six million have been sold and in Great Britain about a quarter of a million (*Electrical Industries*, March 16). They are made of two types. In one class the clock is self-starting and in the other it has to be started if the current stops even for a fraction of a second. In the latter class a red disc usually appears on the rare occasions when it stops. The clocks require only about half the power taken by an ordinary electric meter, and

so the cost of running them is only a few pence a year. In America the sales are usually made by the electric supply companies, but in Great Britain the dealers who sell electric accessories and the clock-makers have taken up their sale. As a rule, the clocks require no attention for many months. In districts supplied by suitable alternating current, it is probable that this type of clock will supersede the escapement and pendulum type. Electric movements can be obtained to replace the ordinary clockwork movement of an existing clock.

#### The *Akron*, the Airship of the United States Navy

IN the new airship *Akron* built for the United States Navy there are incorporated several improvements which set new standards of efficiency for subsequent lighter-than-air machines. The ship is larger than most ocean liners and, unlike most of its predecessors, it is largely actuated by electricity and electrical apparatus. Particulars of the ship are given in the *Westinghouse International* for the first quarter of 1932. The power plant consists of two petrol-driven 11-kilowatt generators, with a motor generator set for battery charging. The total weight allowed for the electrical system on board was only 3000 lb. Aluminium alloys were largely used for the machines and cables, and all the circuits are controlled from the generator room. The radio system takes the heaviest load from the generators. The antenna system consists of two trailing antennae and a fixed wire antenna. The latter is used for landing manoeuvres and for auxiliary purposes. Fire risk is practically eliminated, the twelve supporting gasbags of the ship being filled with helium, but even if they had been filled with hydrogen there would have been little risk of explosion, as every power outlet on the ship is so constructed that the plug cannot be removed or inserted unless its switch is in the 'off' position. Miniature lightning arresters protect the ship from static charges of electricity picked up while the ship is in flight, especially when she changes from one equipotential surface of the earth's electric field to the other. These arresters also drain off any electrostatic charges that might be induced by the ship's radio. The telephone system has seventeen telephones, the switchboard on which the keys and lamps are mounted weighing only thirty pounds. A special feature of the *Akron* is the powerful searchlight which is used for signalling and for landing. It consists of a 500-watt lamp with a fourteen-inch reflector. In daylight tests its light is brilliantly visible at a distance of four miles.

#### Recent Acquisitions at the Natural History Museum

THE Zoological Department of the Museum has secured a mounted example of an exceedingly rare marsupial mouse, *Canolestes obscurus*, from Mount Pichincha, Quito, Ecuador. This species belongs to that group of marsupials which, from the possession of only two incisor teeth in the lower jaw, is known as the Diprotodontia. Except for this solitary species, found in a restricted area of the high Alpine country of the Central Andes in Venezuela, Colombia, Ecuador, and Peru, the diprotodont marsupials are found only in the Australian region. The Department of

Entomology has acquired the important collection of British Coleoptera (beetles) formed by the late Dr David Sharp, who died in 1922. The collection comprises nearly 114,000 specimens, most of which were collected by Dr Sharp himself. Dr Sharp's general collection of Coleoptera, consisting of at least 300,000 specimens from all parts of the world, was purchased by the Museum in 1905. More than 4000 additional foreign specimens have been received with the British collection. The Trustees have approved the purchase for the Department of Geology of a collection of Nothosaurs from the Alpine Trias of Besano. These small swimming reptiles were precursors of the better known Plesiosaurs. The specimens acquired appear to belong to two species of the genus *Pachypleurosaurus*. There has been placed on exhibition in the Department of Geology, near the entrance, the first of a contemplated series of scenes representing the fish-fauna of succeeding geological epochs. It shows reconstruction-models of fish-like animals and true fishes that lived just when the Silurian was passing into the Devonian period. They are the earliest 'back-boned' animals of which fossil remains have been found. The models are posed in an illuminated scene, the surface of the underwater scene being just below the eye of a spectator of average height, at the eye-level, the distant hills of the Old Red Sandstone period are seen.

#### Minerals at the Natural History Museum

IN 1930 the experiment was tried of issuing a free guide-leaflet to the exhibition collections in the Mineral Department of the Natural History Museum at South Kensington. The distribution of the leaflet is helped by some attractive exhibits of popular interest placed near the entrance to the gallery. By these means a considerably larger number of visitors have been induced to take an intelligent interest in the collections. The fact that 20,000 of these leaflets have been taken away by visitors, none being left as litter, proves that they have been appreciated. In the four-page leaflet, attention is especially directed to the various uses of minerals by giving lists of gemstones, ores of the metals, other minerals of economic importance, building and road stones, ornamental stones, and radium-bearing minerals, with the number of the cases in which each may be seen. A third issue of 10,000 copies of the leaflet is now available.

#### Fellowships for Medical Research

THE Rockefeller Medical Fellowships and the Dorothy Temple Cross Research Fellowships in Tuberculosis for the academic year 1932-33 will shortly be awarded by the Medical Research Council, and applications for either should be lodged with the Council not later than June 1. The Rockefeller Fellowships are provided from a fund with which the Medical Research Council have been entrusted by the Rockefeller Foundation, and are awarded to graduates who have had some training in research work in the primary sciences of medicine, or in clinical medicine or surgery, and are likely to profit by a period of work at a university or other chosen centre in the United States before taking up positions for higher teaching

or research in the British Isles. A fellowship held in America will have the value of not less than £350 a year. The Dorothy Temple Cross Research Fellowships give special opportunities for study and research to persons "intending to devote themselves to the advancement by teaching or research of curative or preventive treatment of tuberculosis in all or any of its forms." Candidates must be British subjects and must possess suitable medical, veterinary, or scientific qualifications. The fellowships will preferably be awarded to candidates who wish to make their studies or inquiries outside Great Britain, and are of the value of not less than £350 a year. It may also be possible to award a senior fellowship of considerably greater value to a specially well qualified candidate wishing to undertake an intensive study of some particular problem of tuberculosis at a chosen centre of work in another country. Particulars of these fellowships are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S W 1.

#### International Congress for Anthropology and Ethnology]

THE proposal for the constitution of an international congress for anthropology and ethnology, which was put forward by the Royal Anthropological Institute, has elicited some interesting expressions of opinion from continental anthropologists. Two communications which have been received by the Council are published in *Man* for April. Dr Fritz Krause, of Leipzig, president of the Gesellschaft für Völkerkunde, has been in communication with a number of ethnologists in Austria, Sweden, Holland, and Denmark, and has found that nearly all of them would prefer a congress covering ethnology only. Dr Krause himself personally is in favour of a congress of 'ethnic sciences', of which the mainstay and principal field would be ethnology, but with 'adjacent sciences'—ethnic psychology, sociology, etc.—taken into account and permanently recognised. Dr Krause has offered to push his inquiries further, and thus offer the Council of the Institute has cordially accepted. The second communication is from the Very Rev P. W. Schmidt, who concurs in the view that the interests of ethnology will be best served by a separate congress. In fact, he and his colleagues in Vienna consider that there should be separate congresses for ethnology, anthropology, and prehistory. It is felt, however, that a great advantage would be obtained from a periodically recurring joint congress of all three branches of study. A rotation of four meetings at intervals of two years between each, of which the fourth in each series should be a joint meeting of the three studies, is suggested. This has the obvious disadvantage of an inordinately long interval between the independent meetings in each subject.

#### Medieval Sussex

IN attempting to reconstruct the past geography of England, one of the chief difficulties is to bridge the gap between the Domesday Survey of 1086 and the topographical county descriptions of the seventeenth and eighteenth centuries. In a paper in *Geography* for March, Mr R. A. Pelham has indicated

some sources from which data can be obtained for these centuries, and has outlined the use to which they may be put in the county of Sussex. The distribution of various types of building-stone, when a stone was used outside its area of occurrence in the fabric of a church, throws light on means of transport, especially the navigability of rivers, since waterways were the only satisfactory means of moving heavy materials. Evidence of this source can be strengthened by sheriffs' administrative accounts. These do not give the precise route but the distance and the cost of transport. The sheriffs' accounts also give much evidence concerning the distribution of crops, timber, and wool production. Lastly, much valuable information can be obtained from taxation accounts, particularly the lay subsidy of 1327. This gives a guide to the location of the areas of greatest prosperity. Mr Pelham has illustrated his paper with maps of various aspects of the fourteenth century geography of Sussex.

#### Ice in Arctic Seas

THE Danish Meteorological Institute has published its report on the ice in arctic seas in 1930 (*Isforholdene i de Arktiske Have*). There appears to have been a repetition of the unusual conditions marked by the lack of ice in many seas in 1930. In Spitsbergen the fjord ice was late in forming and relatively thin, and so early as April the western part of the north coast had open water, and by June there was access to the north-east. During July and August the waters of the archipelago were almost free from ice. In the Barents Sea the edge of the ice was unusually far north throughout the summer, and in August a great deal of Franz Josef Land was accessible in open water, which is not usual. The Kara Sea had scattered ice in July but was almost entirely clear in August. So late as November there was little ice in the White Sea. In the east coast of Greenland conditions were less abnormal, but from August until November there was little or no ice off Angmagssalik. The coasts of Iceland were free from ice throughout the year, and south-west Greenland had less ice than usual. Hudson Strait was clear of ice about a month earlier than usual and, except for icebergs, was still free in October. From Siberian waters there were few reports. On the north coast of Alaska the ice lay closely packed throughout the summer. The report is illustrated with the usual charts for each of the spring and summer months.

#### Abstracts of Meteorological Literature

THE *Meteorological Magazine* for March 1932 contains particulars of a collection of abstracts of meteorological literature which has been undertaken by the Meteorological Office, Air Ministry. The abstracts are being gathered from various sources, including authors' own summaries, translated into English where necessary, and a number of meteorologists have volunteered their assistance in summarising papers for which no abstracts are otherwise available. The collection already numbers about a thousand, covering a period of nearly ten years, and it is hoped to include every important paper published in future. The abstracts are being classified according to subject,

the classification adopted being that of the International Catalogue of Scientific Literature, which is also employed in the Royal Meteorological Society's Bibliography, the new collection of abstracts will thus form a very useful complement to the latter. The abstracts will not be published, but will be kept in the Meteorological Office Library for reference.

#### Bibliography of Seismology

THE study of earthquakes and of the transmission of earthquake waves through the earth has lately made such rapid advances that any attempt to enumerate the memoirs published is welcome. We have received from the Dominion Observatory at Ottawa, which is now solely responsible for its publication, copies of recent issues of the *Bibliography of Seismology*, edited by Mr E. A. Hodgson. The number for July-Sept. 1931 contains the titles, with occasional brief abstracts, of a hundred papers. Most countries in which earthquakes are studied are represented, though somewhat unequally, more than one-half of the papers being published in the United States and Great Britain and only two in Italy.

#### British School of Archaeology in Iraq

IT is announced that the subscribers to the fund for establishing a British School of Archaeology in Iraq in memory of the late Miss Gertrude Bell have appointed a council on which the Universities of Oxford, Cambridge, Edinburgh, Durham, and London are represented. In addition, there are representatives of the British Museum, the British Academy, the Royal Geographical Society, the Royal Asiatic Society, the Society of Antiquaries, and other learned societies. The following have been appointed as officers: Sir Percy Cox (president), Sir Edgar Bonham Carter (chairman of the executive committee), Mr E. H. Keeling (hon. secretary), and Brigadier-General Sir Osborne Mance (hon. treasurer). The offices of the School for the present will be at 20 Wilton Street, London, S.W.

#### Scenery Preservation in New Zealand

THE preservation of natural scenery by the institution of reserves is an active policy of the New Zealand Government. The report on scenery preservation of the year ending March 31, 1931, records additional reserves during the year of 131,415 acres, making a total of well over half a million acres. Notable additions include Lake Okareka and surroundings, and some two hundred square miles embracing the Fox Glacier, and the Copland and Twain Rivers, and many prominent mountain peaks. Some of the smaller reserves have been set aside for historical and anthropological reasons, but most are scheduled in order to preserve scenery and natural vegetation.

#### Announcements

THE Kelvin Medal of the Institute of Civil Engineers for 1932 has been awarded to the Marchese Guglielmo Marconi, and the presentation will be made by Lord Rutherford at the Institute on Tuesday next, May 3, at 5 P.M.

A VARLEY centenary commemoration meeting will be held at the Institution of Electrical Engineers on

May 5 A short discourse on the lives and work of Cromwell Fleetwood Varley (April 6, 1828) and Samuel Alfred Varley (March 22, 1832) will be delivered by Lieut-Col A G Lee The annual general meeting of the Institution will follow this meeting

THREE public lectures arranged by the National Institute of Industrial Psychology (under the Heath Clark Bequest), on "Psychological and Social Factors in Business Rationalisation", will be delivered by Dr Charles S. Myers, principal of the National Institute of Industrial Psychology, May 4, 11, and 18, at 5 30 P M The lectures will be given at the London School of Economics and Political Science, Houghton Street, Aldwych, W C 2

THE writer of the obituary notice of the late Sir Horace Plunkett which appeared in NATURE for April 16 has been reminded that Sir Robert Blair was Assistant Secretary for Technical Instruction in the new Irish Department from 1900 until 1904, before he became Education Officer of the London County Council The two 'aliens' whom Sir Horace introduced were thus both Scots

A PRELIMINARY programme has been issued of the centenary meeting of the British Medical Association, to be held in London on July 21-30 under the presidency of Lord Dawson of Penn The meetings will be held at the British Medical Association House, Tavistock Square, W C 1 Lord Dawson will deliver his presidential address on July 26 at the Queen's Hall The popular lecture to the Association will be delivered on July 29 by Prof Julian S Huxley An exhibition of surgical appliances, drugs, foods, books, etc., will be open on July 26-29 at the University of London, Imperial Institute Road, S W.7 On July 24 a pilgrimage will be made to Worcester to unveil two memorials to Sir Charles Hastings, who founded the Association there in 1832

THE programme of experiments to be carried out during the coming season at Jealott's Hill, the Agricultural Research Station of Imperial Chemical Industries, Ltd., at Bracknell, near Maidenhead, Berks, includes experiments on fertilisers for grain, root, and green crops, and also on the intensive management of grassland The demonstrational small-holding has entered its second complete season, and the results of the first year's working are available An open invitation is extended to all interested in agriculture to inspect the Station Visitors are the guests of the Station at lunch or tea, but it is desirable that two or three days' notice should be given of an intended visit

THE advanced courses in anthropology, sociology, and comparative philology in the University of London announced for delivery in May promise to be of exceptional interest On May 2, 4, and 6, Prof G Morgenstierne of the University of Gothenburg will lecture on "The Káfirs of the Hindu Kush" The lectures will be delivered at 5 30 P M at the School of Oriental Studies, Finsbury Circus, E C, and will deal with the ethnology and culture of the

people, as well as with their linguistics On May 5 and 12, at 5 P M, Dr R R Marett, Rector of Exeter College, Oxford, will lecture at the London School of Economics on "Covenant in Primitive Economics, Law, and Religion" Prof A M Tallgren, professor of archaeology of Finland and the Northern Countries in the University of Helsingfors, will lecture at University College on May 23 and 25 on "Central Asiatic and Siberian Rock Pictures" The lectures will begin at 5 30 Admission to all these lectures is free and without ticket

A CATALOGUE of second-hand books on natural history has been issued by James Thim, 54-56 South Bridge, Edinburgh The 2497 items in the list range over a wide field in zoology, botany, and agriculture and husbandry

A NEW book by Max Planck, entitled "Where is Science Going?", with introduction and epilogue by Einstein, is promised by Messrs Allen and Unwin for the autumn These publishers also announce "Science A Symposium", a collection of essays by Bertrand Russell, Prof Julian Huxley, Prof J B S Haldane, Hilaire Belloc, Sir Oliver Lodge, Sir Thomas Holland, John Baker, Hugh L'Anson Fausset, and Prof H Levy

A NEW publication dealing with general and comparative physiology has been undertaken by the Wistar Institute of Anatomy and Biology, Philadelphia This *Journal of Cellular and Comparative Physiology*, which will be published in alternate months, under a responsible board of editors, commenced publication on Feb. 20 The volume will contain about 500 pages and may be closed with any issue The price will be 5 50 dollars outside the United States

APPLICATIONS are invited for the following appointments, on or before the dates mentioned—An assistant lecturer in agricultural economics in the University of Leeds—The Registrar, University, Leeds (May 2) An assistant veterinary inspector under the Surrey County Council—The Chief Veterinary Officer, County Hall, Kingston-upon-Thames (May 10) A superintendent of Epping Forest—The Town Clerk, Guildhall, E C 2 (May 11) A woman lecturer in geography at St Gabriel's College, Camberwell—The Principal, St Gabriel's College, Cormont Road, Camberwell, S E (May 14) A lecturer in geography at Armstrong College—The Registrar, Armstrong College, Newcastle-upon-Tyne (May 14) Two assistant lecturers in the School of Economics and Commerce, Dundee, in, respectively, industrial administration and commerce—The Principal, School of Economics and Commerce, Dundee (May 23) A director of the British Non-Ferrous Metals Research Association—The Chairman of the Association, 168 Regent Street, W 1

ERRATUM—In the article "Flame Movements in Gaseous Explosions", in NATURE for April 16, p 565, line 5, for "Campbell and Woodward (1926)" read "Campbell and Woodhead (1926)"



## Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

## Disintegration of Lithium by Swift Protons

In a previous letter to this journal<sup>1</sup> we have described a method of producing a steady stream of swift protons of energies up to 600 kilovolts by the application of high potentials, and have described experiments to measure the range of travel of these protons outside the tube. We have employed the same method to examine the effect of the bombardment of a layer of lithium by a stream of these ions, the lithium being placed inside the tube at 45° to the beam. A mica window of stopping power of 2 cm. of air was sealed on to the side of the tube, and the existence of radiation from the lithium was investigated by the scintillation method outside the tube. The thickness of the mica window was much more than sufficient to prevent any scattered protons from escaping into the air even at the highest voltages used.

On applying an accelerating potential of the order of 125 kilovolts, a number of bright scintillations were at once observed, the numbers increasing rapidly with voltage up to the highest voltages used, namely, 400 kilovolts. At this point many hundreds of scintillations per minute were observed using a proton current of a few microamperes. No scintillations were observed when the proton stream was cut off or when the lithium was shielded from it by a metal screen. The range of the particles was measured by introducing mica screens in the path of the rays, and found to be about eight centimetres in air and not to vary appreciably with voltage.

To throw light on the nature of these particles, experiments were made with a Shimizu expansion chamber, when a number of tracks resembling those of  $\alpha$ -particles were observed and of range agreeing closely with that determined by the scintillations. It is estimated that at 250 kilovolts, one particle is produced for approximately  $10^9$  protons.

The brightness of the scintillations and the density of the tracks observed in the expansion chamber suggest that the particles are normal  $\alpha$ -particles. If this point of view turns out to be correct, it seems not unlikely that the lithium isotope of mass 7 occasionally captures a proton and the resulting nucleus of mass 8 breaks into two  $\alpha$ -particles, each of mass four and each with an energy of about eight million electron volts. The evolution of energy on this view is about sixteen million electron volts per disintegration, agreeing approximately with that to be expected from the decrease of atomic mass involved in such a disintegration.

Experiments are in progress to determine the effect on other elements when bombarded by a stream of swift protons and other particles.

J. D. COCKCROFT  
E. T. S. WALTON

Cavendish Laboratory,  
Cambridge,  
April 16.

<sup>1</sup> NATURE, 129, 242, Feb. 13, 1932.

## Isotopic Constitution of Lead from Different Sources

THANKS to the generous co-operation of Dr. v. Grosse and other chemists in supplying me with the requisite rare materials, I have been able to repeat and amplify my analyses of lead from different geological sources. During these experiments, which I hope to extend, technical improvements were effected so that, in spite of the difficulties inherent in the problem, results have been obtained upon which considerable reliance may be placed.

The effect of the presence of hydrides due to the methyl compounds has been measured and can be allowed for. Under the particular conditions used, it amounts to 2.3 per cent. Thus in the lightest lead (II) though the line 207 had an apparent intensity of 9.5 (line 206 = 100), its true relative abundance is estimated to be  $7.2 \pm 0.3$ , in good agreement with the value 7 assumed by Lord Rutherford<sup>1</sup> for his calculations on actino-uranium. Several rare isotopes previously suspected in ordinary lead<sup>2</sup> have now been confirmed but their abundances are too small to be certain. The percentage analyses are as follows—

| Chemical      | I      | II      | III     | IV      |
|---------------|--------|---------|---------|---------|
| Atomic Weight | 207.22 | 206.048 | 206.195 | 207.90  |
| 203           | (0.04) |         |         |         |
| 204           | (1.50) |         |         |         |
| 205           | (0.03) |         |         |         |
| 206           | 27.75  | 93.3    | 85.9    | 4.6     |
| 207           | 20.20  | 6.7     | 8.3     | 1.3     |
| 208           | 49.55  | (0.02)  | 5.8     | 94.1    |
| 209           | (0.85) |         |         |         |
| 210           | (0.08) |         |         |         |
| Mean Mass     |        |         |         |         |
| Number        | 207.19 | 206.067 | 206.20  | 207.895 |

I Ordinary lead

II Lead from Katanga pitchblende (Honigschmid and Birkenbach *Ber. Deutsch. Chem. Gesell.*, 56, 1837, 1923)

III Lead from Wilberforce uraninite (Baxter and Bliss, *J. Amer. Chem. Soc.*, 52, 4851, 1930)

IV Lead from Norwegian thorite (Fajans, *Sitz. Heidelberger Akad. Wiss.*, 3, 1918)

The packing fractions of the leads will be very difficult to ascertain, but appear to be in the region 0 to +1. They will tend to cancel the correction (still uncertain) to the chemical scale, so that the mean mass-numbers should show agreement with the chemical atomic weights, which is the case. It is noteworthy that the quantities of 206 and 207 in (IV) do not correspond to those expected from ordinary lead present as an impurity.

F. W. ASTON

Cavendish Laboratory,  
Cambridge,  
April 12

<sup>1</sup> NATURE, 123, 313, March 2, 1929.

<sup>2</sup> NATURE, 120, 224, Aug. 13, 1927.

## Oxygen and Everest

ON the interesting subject of the need for oxygen on Mount Everest, Prof. J. Barcroft has made the remark, before Section I of the British Association, that the whole matter is now merely "an engineer's problem"—the problem of designing a light and efficient oxygen breathing apparatus. This point of view is ably supported by Prof. Margaria<sup>1</sup>. There is, however, something more—namely, the disadvantage of acclimatisation in a man using such apparatus. If it is one of the 'open circuit' type, acclimatised breathing causes a huge waste of oxygen and adds correspondingly to the difficulty of transportation. Yet a man dare not relinquish this physiological condition, even if he could. For if he relinquished it, he would die of asphyxia as soon as he took the apparatus off.

A man adjusted to sea-level conditions breathes about ten litres of air for each gram of carbon dioxide exhaled. When acclimatised to 20,000 ft he breathes about twenty litres per gram of carbon dioxide. At rest at sea-level he breathes 5-7 litres of air per minute. At rest on the North Col of Mount Everest, with the same carbon dioxide production, he probably breathes 10-14 litres. This does not incommode him at all. When he exercises and produces 4-6 gm of carbon dioxide per minute, he breathes 40-60 litres at sea-level, but 80-120 litres on Mount Everest. 40-60 litres per minute is merely heavy breathing, but 80-120 litres is intolerable for more than a minute or two. A man cannot walk while doing it. The reason for this difference lies in the fact that, in acclimatisation, the blood alkali is reduced in proportion to the altitude and oxygen pressure to which the man has become adjusted, and the less the blood alkali, the larger must be the 'dilution ratio' that is, the volume of air breathed per gram of carbon dioxide produced and exhaled. This adjustment is acquired very slowly, and is reversed again equally slowly, through days or even weeks, on return to sea-level.

As Prof. Barcroft was the first to show, the balance of acid and alkaline elements in the blood is the same at altitudes as at sea-level, but the amounts of each are not the same. The acid element is carbonic acid in equilibrium with the carbon dioxide in the air of the lungs and controlled by their ventilations. It was shown by Haldane, Douglas, Schneider, and Henderson on Pike's Peak that, because of the increased breathing, the partial pressure of carbon dioxide in the lungs and, therefore, the carbonic acid of the blood are diminished in proportion to the altitude. So also are the bicarbonates, which are the alkaline element in the blood. The reduction of the acid proportionally with the alkali is essential to maintain the hydrogen ion concentration of the blood at its normal value. In order to keep the quantity of carbonic acid down to an amount to correspond with the decreased blood alkali, the volume of breathing must be increased in inverse proportion to the bicarbonates in the blood.

Accordingly, when a man fairly well acclimatised to the altitude of the North Col puts on an oxygen apparatus and does the heavy work of climbing with it on his back, the increased production of carbon dioxide induces so large a volume of breathing that he can make but a few steps at a time. The hyperpnœa may be almost as intolerable as if he were breathing merely the thin air, for in the man it is induced by the large 'dilution ratio' due to the low blood alkali. Without the apparatus, the oxygen deficiency merely reinforces, to some extent, the hyperpnœa due to carbon dioxide. Inhalation of oxygen, therefore, does little to ease the violence of the breathing after each few yards of the struggle upward.

Some men acclimatise slowly and with difficulty. They suffer from prolonged mountain sickness, as Dr Douglas and Prof Schneider did on Pike's Peak,<sup>2</sup> and as, I believe, Prof Barcroft does to an even greater extent. For them oxygen is the very breath of life. Others like Dr J. S. Haldane (as I saw on Pike's Peak), and like Mr Odell and others of the advanced parties in the attacks on Mount Everest, acclimatise so easily and well that oxygen helps them less than the weight of an apparatus impedes. For the first type, who have what we may call 'sea-level respiratory centres', the ascent of Everest is largely an "engineer's problem." They should fly direct and wholly unacclimatised to the North Col, don an improved apparatus, make the ascent, and get back below 15,000 ft while the supply of oxygen holds out. The other type acclimatizes readily, and during the gradual

ascent through Tibet they become so well adjusted to low pressures of oxygen that, although the risks are great, a party of such men with no apparatus may some day reach the summit.

There is one development, however, that, I think, we shall never see—namely, agreement between the advocates of oxygen apparatus and those whose experience teaches them to rely wholly on acclimatisation.<sup>3</sup> Prof Margaria comments upon the fact that on this matter "there is no accord among physiologists", to which I would add that the disagreement lies not in their minds merely, but fundamentally in their respiratory centres. How can a man of either opinion accept the other, when his own is to him as obvious as breathing? The whole science of respiratory physiology would to-day be different from what it is if its author, Dr Haldane, had not happened to have a respiratory centre of the type that is most completely controlled by carbon dioxide, yet acclimatizes fairly easily. Those who disagree with him on such matters as acclimatisation, do so, not so much because they think differently, as because they breathe differently.

YANDELL HENDERSON

Yale University,  
New Haven, Conn.,  
March 30

- <sup>1</sup> Margaria, R, *NATURE*, 129, 397, March 12, 1932.  
<sup>2</sup> Douglas, Haldane, Henderson, and Schneider, *Phil. Trans. Roy. Soc. B*, 203, 185, Feb 7, 1913.  
<sup>3</sup> Henderson, Y, *NATURE*, 117, 747, May 29, 1926.

### The Cry of Tin

It is an observation of respectable antiquity that when a bar of tin is bent it emits a characteristic creaking, known as the 'cry of tin.' According to Mellor,<sup>1</sup> who is one of the few authorities to refer to the subject, the cry "is supposed to be produced by the grinding of the crystals against one another during the bending of the metal", and I have been unable to find in the literature any more definite explanation of its origin. In the course of some experiments which I have been carrying out with Prof E. N. da C. Andrade on single crystal wires I have made observations which, I think, make possible a rather more precise attribution of the sound.

I have obtained the cry with cadmium as well as with tin. When single crystal wires of these metals are stretched, the deformation takes place in two stages, a slip on the glide planes, which constitute in both cases a unique system, being succeeded by a mechanical twinning on a specified plane. The twinning does not take place until after a definite amount of glide extension has occurred, which enables the two phenomena to be studied separately.

With single crystal wires no sound is produced during the glide stage of extension, but with both metals twinning is accompanied by the characteristic creaking or tearing sound. The same sound also occurs when such wires are violently bent or twisted, a process which gives rise to the surface marking characteristic of twinning, although it does not allow the separation of twinning from other effects in the way that simple extension does.

The tin with which the phenomenon is normally observed is in a polycrystalline state. Although the cry occurs when polycrystalline cast rods of both tin and cadmium are bent, drawn wires of small diameter do not give it unless they are annealed, or, in other words, the production of the sound depends on the size of the crystallites being greater than a certain minimum—larger crystals, of course, being subjected to more severe strain when the metal is bent. It is reasonable to suppose that the cry is an accompani-

ment of twinning in the case of the polycrystalline state as well as in the single crystal state

Preliminary measurements on cadmium indicate that whereas the heat evolved in the twinning is of the order of 0.1 calories per gram, less than one-tenth of this amount is produced during the whole extension accompanying gliding, although this extension is considerably greater than that due to the twinning. The measurements, which are being followed up with more accurate methods, give, at present, only rough approximations, but suffice to establish clearly this very much greater heating which accompanies twinning. This observation suggests that some of the mechanical energy that is supplied to the lattice to cause twinning is afterwards liberated as heat energy and, in particular cases, as sound energy, the cry of tin and cadmium being a manifestation of the latter.

It may be added that while a cry can be produced from zinc, which crystallises in the hexagonal system and twins readily, I have not been able to produce a cry with any metal crystallising in a cubic system, for which twinning does not take place.

BRUCE CHALMERS

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University College, London,  
April 6

<sup>1</sup> "Complete Treatise of Inorganic Chemistry", vol. 7, p. 296

THE observations of Dr Chalmers described in the above letter, which are being followed up, seem to me likely to prove of considerable importance for elucidating the problem of twinning. The generation of heat agrees with the view that, in twinning, the molecules, when sufficient energy is applied, slip from one equilibrium position to another, about which they then execute heavily damped vibrations, the energy of vibration dissipating itself in heat and probably in radiation of a frequency of the *Reststrahlen* order. The sound indicates that the twinning does not take place over the whole region of twinning simultaneously, for the sound frequency is much too low to be connected with the vibration of molecules or molecular units, but is propagated from layer to layer with a velocity or velocities of the order of sound velocity. It is possible that in the case of substances where sudden twinning is unaccompanied by audible sound, the sound exists, but is of too high a frequency to be heard.

E. N. DA C. ANDRADE

#### Climatic Changes in British Somaliland

THE alternation of climatic conditions in East Africa during Pleistocene time has recently been brought into prominence in connexion with the history of early man, and it accordingly became of interest, the opportunity presenting itself, to ascertain whether the results obtained in Kenya could to any degree be paralleled in Somaliland.

Fifteen months of almost continuous travel in the British Protectorate led to tentative first conclusions, which, if the coastal belt could have been included, would probably have been more definite. Evidence in the districts traversed was somewhat hard to find, but in the west, the Buramo district, tenanted by the Gadabursi people, steep V-shaped valleys give proof of an early and strong period of erosion, whereby bold, rugged scenery has been carved out of a complex of crystalline rocks. To this time may also be attributed sundry high-level deposits, that is, in the east on the Sorli Haud, and in the Gadabursi country, where conglomerates, often extremely coarse, were noted in several places, at various levels above the present surface of weak and spasmodic erosion.

It is interesting that, although the final movement of the coast-line was one of elevation, this was preceded, in the west at least, by subsidence, whereby deposits of coral and shelly sands and clays were laid down. At Zeilah, these proved to be about three hundred feet thick and were underlain by a spherulitic rhyolite. Some twenty-five miles to the south and about fifteen miles from the sea, these marine deposits are replaced by uniform sticky brown clays, containing occasional pebbles, doubtless deltaic and lagoon deposits. A bore put down in such a position did not reach the floor of crystalline or pre-Pleistocene rocks at 250 ft, but was probably not far off. It is to the later part of this period of steady deposition on the west that I would attribute the widely distributed infilling of the hollows and valleys formed by the earlier erosion with a remarkably uniform, slightly clayey sand, the 'tug alluvium',\* of a reddish-brown colour, and sufficiently consolidated to stand in a vertical face. Occasionally small gasteropods, *Planorbis*, for example, are abundant.

This alluvium, although typically unbedded, shows evidence now and again of rapid deposition, for thin layers or strings of pebbles and local false-bedding can be seen in almost every section. In these sands occur, sparingly, artefacts which should afford an archaeological date.<sup>1</sup> Of the period between the erosion of the valleys and the infilling with tug alluvium there appears little evidence, but near Buramo the bottom of the tug section is a very altered basic rock, clearly the result of weathering of the hornblende-schists of the neighbourhood, but to a certain extent reconstructed, as pebbles are found in it.

The alluvium itself, probably seldom exceeding a hundred feet in thickness, has been cut to form the characteristic drainage channels or 'tugs' of Somaliland. Now, these only occasionally contain flowing water, and although spates may assume torrential proportions and carry much sediment, it is clear that the tugs were formed by true rivers, which preceding the present period of slow desiccation, indicate a wet phase. During this time, the final uplift of the coast may have taken place, amounting, according to Dr Macfadyen, to 750 ft in the Berbera district, although apparently much less in the west, where, however, more work is needed. A considerable thickness of alluvium forms the great plains characteristic of the south-central part of the Protectorate.

A well, put down fifty miles east-south-east by south of Hargeisa, passed through 112 ft of calcareous terra-cotta alluvial clay, before reaching the white and brown marls and limestones from which it was doubtless derived. It contained, in this bore, no pebbles, and its deposition is concluded to be of a lacustrine nature and to belong to the period of the tug alluvium. Leakey's "Second major pluvial" I would correlate tentatively with the deposition of the latter, with the period of the erosion of those valleys in which the alluvium lies and the formation of the old conglomerates, his 'Kamasian' and probably somewhat antecedent time, the dissection of the tug alluvium with a post-pluvial wet phase.

The correlation is admittedly unsatisfactory, and it is probable that the variations of climates in British Somaliland will, when worked out, show differences from those of Kenya.

JOHN PARKINSON

Athenæum Club, S W 1,

March 14

\* 'Tug' A sandy, usually dry, drainage channel, of very variable breadth and cross section.

<sup>1</sup> See R. A. Farquharson, "First Report on the Geology and Mineral Resources of British Somaliland", 1924, p. 18. I was unable to visit the 'tug' in which these implements were found. Also, M. C. Burkitt and C. Barrington-Brown, *Man*, 31, p. 157, 1931 and "Stone Age Antiquities", *Brit. Mus. Guide*, p. 186, 1926.

### The Nuclear Spin of Arsenic

THE fine structures occurring in the lines of the spectrum of As II have been observed by me in the region  $\lambda\lambda 6400-4300$  by means of a Fabry-Perot interferometer with plate separations varying from 5 mm to 25 mm. The source employed was a Geissler tube containing arsenic, helium at a pressure of 2 mm being circulated through the tube. Fifty lines have been observed, thirty-three of which are single, the rest showing fine structure. Most of the lines showing structure involve transitions between the  $4p\ 5s$  and  $4p\ 5p$  electron configurations and divide themselves into two distinct groups. These are, first, degraded regular series, which arise from the fact that only one of the terms involved, usually the  $4p\ 5s$  term, shows appreciable structure, and secondly, complex patterns due to appreciable structure in both upper

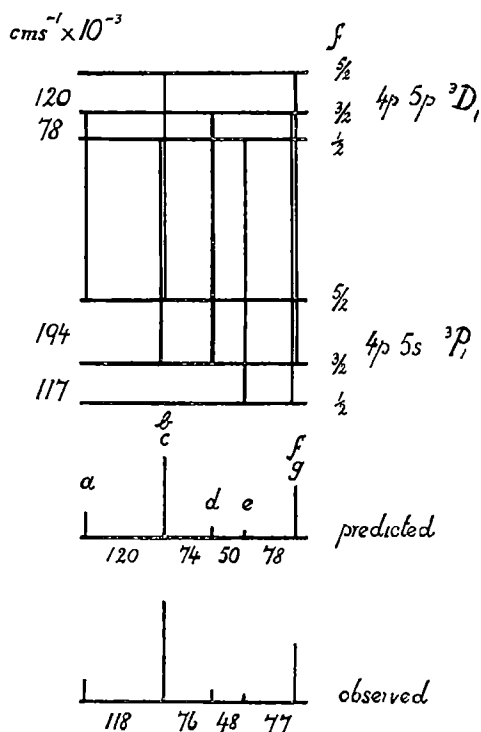


FIG 1

and lower terms. The gross multiplet structure has been analysed by Dr K. R. Rao, who has kindly allowed me to use his unpublished data, and the fine structure observations confirm the gross structure analysis in detail.

Of the  $4p\ 5s\ ^3P$  terms, the terms with  $j=0$  are single, those with  $j=1$  are triple, and those with  $j=2$  are quadruple. The nuclear spin is therefore  $\frac{1}{2}$ . This value is amply confirmed by other data, and the fine structure analyses of the various lines check one another extremely well. For example, the line  $4p\ 5s\ ^3P_0-4p\ 5p\ ^3D_1$  is a regular triplet degraded to the red, the intervals being 120 and  $78\text{ cm}^{-1} \times 10^{-3}$ . This is therefore the term structure for  $4p\ 5p\ ^3D_1$ , since  $4p\ 5s\ ^3P_0$  remains single. Also, the line  $4p\ 5s\ ^3P_1-4p\ 5p\ ^3P_1$  is an extremely sharp triplet degraded to the violet, with intervals 194, 117. Other data prove that the structure of the  $4p\ 5p\ ^3P_1$  term is quite negligible, so that this gives the structure of the  $4p\ 5s\ ^3P_1$  term. From these the fine structure of the line  $4p\ 5s\ ^3P_1-4p\ 5p\ ^3D_1$  can be predicted, and, as shown in Fig 1, the agreement with the structure

actually observed is remarkably exact, both as to intensities and intervals. Since the components  $bc$  and  $fg$  respectively fall right on top of one another, their intensities have been added in forming the predicted pattern.

Attention may be directed to the relatively coarse structure of the  $4p\ 5p\ ^3D_1$  term as compared with the  $4p\ 5s$  terms. Since this term possesses no penetrating  $s$  electron, it is to be expected at first that the structure will be small. However, Breit<sup>1</sup> has shown that in the heavier atoms a  $p_{\frac{1}{2}}$  electron behaves with respect to the nucleus as if it were penetrating, and since the  $4p\ 5p\ ^3D_1$  term is built up out of two  $p_{\frac{1}{2}}$  electrons with parallel coupling, this may be the correct explanation of the relatively coarse structure, as the atomic weight of arsenic is 79. A detailed account of the fine structures will be published elsewhere shortly.

S. TOLANSKY

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March 14

<sup>1</sup> Breit, *Phys. Rev.* **37**, 1182, 1931.

### Infra-Red Absorption Spectra of the Oxides of Chlorine

WE have recently completed an examination of the infra-red absorption spectra of the monoxide and dioxide of chlorine. The unstable nature of these substances demanded the use of a monochromator method; this has the additional advantage of an increased purity of spectrum, but even under these conditions there is a considerable amount of scattered radiation in the region of longer wave-lengths. We have endeavoured to take advantage of the alteration in the chromatic foci of rocksalt to stop out most of the scattered light, but owing to the lack of transparency of this substance beyond  $18\mu$  (the optical train included rocksalt lenses and plates for the absorption cells and thermopile case), we obtained no measurable deflections on the galvanometer. The provision of optical parts of potassium bromide should eventually solve this difficulty. The observed bands for  $\text{ClO}_2$  are recorded in the accompanying Table.

| Band | ( $\lambda$ ) $\mu$ | Maxima ( $\text{cm}^{-1}$ ) | P-R $\Delta\nu$ ( $\text{cm}^{-1}$ ) | Relative Intensity | Origin          |
|------|---------------------|-----------------------------|--------------------------------------|--------------------|-----------------|
| B    | 10.57               | 932<br>963                  | 31                                   | 30                 | $\nu_2$         |
| C    | 9.017               | 1095<br>1105<br>1123        | 28                                   | 80                 | $\nu_3$         |
| D    | 5.307               | 1870<br>1884<br>1900        | 30                                   | 0.5                | $2\nu_2$        |
| E    | 4.916               | 2034                        | —                                    | 4                  | $\nu_2 + \nu_3$ |
| F    | 4.246               | 2355                        | —                                    | 0.5                | $2\nu_3$        |

$\nu_1$  for this molecule falls outside the range of our spectrometer; recent work by Urey and Johnston<sup>1</sup> gives a probable value of  $529\text{ cm}^{-1}$  for this fundamental. The spectrum is very similar indeed to that of sulphur dioxide, this fact is perhaps to be connected with the 'odd' electron structure of  $\text{ClO}_2$ , there being no corresponding proper function in this case to satisfy the odd electron, and except for the instability associated with this, we have for the rest of the molecule much the same external electronic structure in the two substances.

We have extended the examination of the possible modes of vibration for the symmetrical triangular

molecule, and a determination of the molecular constants with given conditions makes it finally probable that both  $\text{SO}_2$  and  $\text{ClO}_2$  are equilateral triangles, the length of side being approximately 1.37 Å in each case, while there is a single linking between the oxygens and the central atom. The two molecules both have in addition a non-localised proper function, which in the case of sulphur dioxide is filled with two electrons giving a non-localised bond accounting for the stability of the substance compared with the chlorine compound. This application of a conception recently due to Hund<sup>2</sup> is confirmed by the values of the force constants, which are  $9.7 \times 10^5$  dynes per cm for  $\text{SO}_2$ , and  $6.7 \times 10^5$  dynes per cm for  $\text{ClO}_2$ . An equilateral triangular structure is probably the only structure compatible with non-localised proper functions.

In the case of chlorine monoxide certain of the bands overlap, and the observed values cannot at present be taken as more than reasonable approximations. We have  $\nu_1 = 639$ ,  $\nu_2 = 973$ ,  $\nu_3 = 1245$ ,  $2\nu_1 = 1305 \text{ cm}^{-1}$ . On the older polarisation theory one would have expected a rectilinear structure for this substance. Examination shows, however, that the molecule is triangular with vertical angle approximately  $90^\circ$  and again single linkings ( $f_1 = 6 \times 10^5$  dynes/cm.) between the chlorine and oxygen atoms. The existence of a considerable repulsive force between the two chlorine atoms is shown by the magnitude of  $f_2$ , the force constant for the particles at the base of the triangle, which rises from  $1.7 \times 10^5$  dynes/cm for  $\text{SO}_2$  and  $\text{ClO}_2$  to  $5 \times 10^5$  dynes per cm for  $\text{Cl}_2\text{O}$ .

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<sup>1</sup> *Phys. Rev.*, **38**, 2131, 1931  
<sup>2</sup> *Z. Phys.*, **73**, 1 and 565, 1932

### Fluted Band at $\lambda 3900 \text{ Å}$ . in the Spectrum of Mercury

It has already been observed by J. Stark and by others that a fluted band system of mercury at  $\lambda 3900 \text{ Å}$  is superposed on the continuous spectra, covering the visible and the ultra-violet regions, but, so far as we know, nothing has been reported about the origin of this band.

We have observed the band, and Fig. 1 is a reproduction of its photometric curve. We excited the

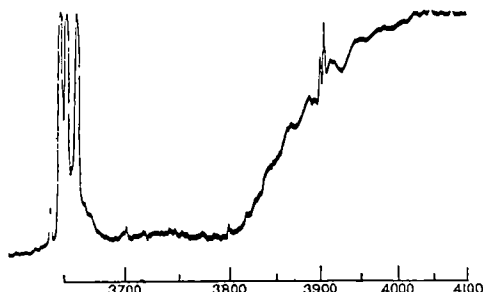


FIG. 1—Photometer curves of the mercury band spectrum with wave-length scale in angstrom units

vapour with a high-frequency oscillatory current of about  $5 \times 10^8$  cycles. The oscillation was produced by a spark maintained by a valve oscillator working at  $3 \times 10^5$  cycles. On plotting the frequency differences as a function of wave-number, as shown in Fig. 2, the convergence limit was estimated to be  $27,150 \text{ cm}^{-1}$ ,

which falls near the strong triplet lines at  $\lambda 3650 \text{ Å}$ . Therefore it seems reasonable to assume that the band has a close relation with these lines. From this point of view, it is considered that the bands are connected with the  $3^3D$  state of the mercury atom,

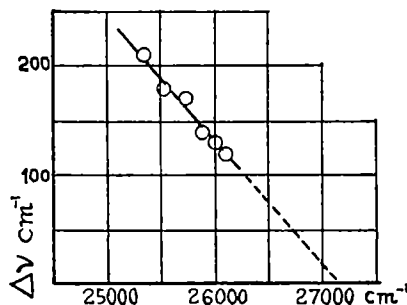


FIG. 2

consequently they are emitted by the transitions between the levels the dissociation products of which are the excited  $3^3D$  atom, and the normal, and the next lower levels connected with the  $2^3P$  of the atomic states, from which, as it is usually accepted, the other visible and ultra-violet band systems are initiated.

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### A New Band System of Beryllium Oxide

In an attempt to get bands of the beryllium molecule, I found in an arc between a carbon and a beryllium electrode several new bands in the red and infra-red region. The analysis of these bands showed that they are, however, not due to beryllium but to the oxide,  $\text{BeO}$ , the lower level being the same as that of the well-known visible  $\text{BeO}$ -bands analysed by Bengtsson,<sup>1</sup> and Rosenthal and Jenkins.<sup>2</sup> As until now only two electronic states (both  $^1\Sigma$ ) of the molecule  $\text{BeO}$  are known, namely, the lower and upper states of the visible bands, it seemed worth while to analyse the new bands in detail, in order to get more information about the electronic structure of this molecule, especially with respect to the question of valence and dissociation products.

The heads of the bands, which are shaded towards the red, are not very pronounced, and since there is much overlapping of different bands, the whole system looks under high dispersion rather like a many-line spectrum. The analysis showed that in spite of their complicated appearance, the bands have only single  $P$ ,  $Q$ , and  $R$  branches. As the lower state is  $^1\Sigma$ , the transition is  $^1\Pi \rightarrow ^1\Sigma$ , the  $^1\Pi$  level lying between the two  $^1\Sigma$  levels mentioned above. This upper level is just the state one would expect according to the electronic configuration of  $\text{BeO}$ .<sup>3</sup>

So far, three bands have been analysed (Table 1)

TABLE 1

| $v'$ | $v''$ | 0     | 1     |
|------|-------|-------|-------|
| 0    |       | 13647 |       |
| 1    |       | 14710 |       |
| 2    |       |       | 14293 |

The  $v'$ -numbering may be shifted, if more bands are found, farther in the red. The vibrational quantum of the upper state ( $^1\Pi$ ) is very much lower than that of the ground state ( $^1\Sigma$ ), as calculated by Rosenthal and Jenkins.<sup>2</sup> The  $\Delta G'$  values are  $\Delta G'_1 = 1063$ ,

$\Delta G''_1 = 1047$ ,  $\Delta G''_2 = 1464$ ,  $\Delta G''_3 = 1440$  (calculated from band origins, not from heads) The same is true for the values of  $B$  (Table 2) In Table 2 are given the  $B$  values for both states, as well as those for  $r$  and  $a$  The  $B''$  values coincide with those calculated by Rosenthal and Jenkins for the lower  $^{12}\Sigma$  level

TABLE 2

|                       | $B$   |                            |
|-----------------------|-------|----------------------------|
| $^{12}\Sigma$ $v''=0$ | 1 643 | $r''_0 = 1.33 \text{ \AA}$ |
| $v''=1$               | 1 623 | $a''_0 = 0.020$            |
| $^{12}\Pi$ $v'=0$     | 1 296 |                            |
| $v'=1$                | 1 230 | $r'_0 = 1.50 \text{ \AA}$  |
| $v'=2$                | 1 266 | $a'_0 = 0.015$             |

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March 15

<sup>1</sup> *Ark. Mat. Astron. och Fys.*, 20 A, 1, 1928

<sup>2</sup> *Phys. Rev.*, 33, 163, 1929

<sup>3</sup> Cf. R. S. Mulliken, *Phys. Rev.*, 32, 186, 1928, and G. Herzberg, *Z. Phys.*, 57, 601, 1929

### Coacervation

In a preliminary communication Kruyt and Bungenberg de Jong<sup>1</sup> proposed the name *coacervation* for the phenomenon of separation into two liquid layers in systems containing one or more compounds in the colloidal state

The separation takes place under the influence of several agents (for example, electrolytes, alcohols, polyphenols) at a temperature above the temperature of gelation

Kruyt and de Jong suggested a typical difference between the analogous phenomena in molecularly dispersed systems, studied by the classical phase-theory, and the peculiar type of flocculation already mentioned

We have analytically determined the composition of the co-existing liquids in the systems water-gelatin-ethanol, w.-g.-sodium sulphate, and w.-g.-resorcinol. The preparation used in our experiments was ash-free iso-electric gelatin, prepared by means of Loeb's method

It should be pointed out that, in all cases, we were dealing with perfect equilibria and that nearly all the protein was present in the lower layer, the upper layer being practically free of gelatin

Moreover, there is a decided difference between the influence of ethanol and sodium sulphate on one hand and resorcinol on the other as indicated below.

| Ethanol                                                             | Sodium sulphate | Resorcinol                                                         |
|---------------------------------------------------------------------|-----------------|--------------------------------------------------------------------|
| Rather large concentrations required for separation                 |                 | Separation takes place at exceedingly small concentrations         |
| Ratio of water to agent greater in lower layer than in upper layer  |                 | Ratio of water to agent smaller in lower layer than in upper layer |
| Separation does not disappear at higher concentrations of the agent |                 | Separation disappears at a certain concentration of the agent      |

The lower layer may be considered as an accumulation of micellæ, only separated by a binary liquid. This explains the name 'coacervate' for the sub-layer (*acervus* = heap)

It is well known that Einstein's formula for the relative viscosity of sols enables us to calculate the volume connected with the colloidal matter in solution. We have plotted this volume against the concentration of one of the above-mentioned agents. We have also, in the same diagram, shown the

volumes of the corresponding coacervates, calculated per gram gelatin. As a matter of fact, the data used by the first method were obtained at lower concentrations, whereas the results of the second experiments were related to large concentrations of the agent. It is interesting to note that both curves nearly coincide.

Through these and other facts we are led to the conclusion that one might well consider the micellæ as a 'wall-substance' covered with a layer of solvating matter. It will be noted here that our analysis brings out the relationship existing between the composition of the solvate film and the upper layer.

The fact is that the presence of a solvate film has always been considered as one of the stabilising factors of a sol (electric charge and solvation), but in our case it is clear that we have to seek the stabilising factor especially in the transition solvate film-medium.

The existence of stability is due to the fact that this transition bears a continuous character. Under the influence of dehydrating agents, this transition becomes discontinuous at the critical concentration of the agent: the diffuse solvation film has become concrete and thus gives rise to a surface tension. The origin of coacervation is decrease of the total free surface energy.

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<sup>1</sup> *Proc. Royal Academy of Amsterdam*, 32, 849, 1929

### Fats of Brown Sea-weeds

INVESTIGATIONS recently carried out in this department on the marine algæ have shown that there would appear to be some connexion between the depth of immersion of such weeds and their metabolism, as expressed by their chemical composition. Such connexion has been traced in regard to their carbohydrate<sup>1</sup> and nitrogenous<sup>2</sup> constituents, and the present investigation was undertaken with the view of ascertaining whether a similar connexion holds for the fatty constituents.

The weeds examined in the present instance are *Pelvetia canaliculata*, *Pelvetia canaliculata forma libera*, *Fucus vesiculosus*, and *Laminaria digitata*. *Pelvetia libera* is a free floating marsh form which is exposed to desiccation for considerable periods of time, being immersed only during spring tides. *Pelvetia canaliculata* grows at a lower zone, fixed to stones or rocks, and is covered with water for fairly long periods daily. *Fucus vesiculosus* grows somewhat lower than *P. canaliculata*, but is considerably more exposed than *Laminaria digitata*, which, being a deep sea-weed, is only exposed for a short period during spring tides. These sea-weeds therefore present a fairly wide range of variation in regard to habitat conditions. How far these conditions are reflected in their chemical composition may be seen from the results below.

The petrol ether extract—though representing a mixture of substances besides true fat—shows a regular decrease with depth of immersion, and the same holds for the true fat content, as calculated from the fatty acids isolated from the extracts.

|                              | Petrol Ether Extract | Iodine Value of Extract | Percentage True Fat |
|------------------------------|----------------------|-------------------------|---------------------|
| <i>Pelvetia libera</i>       | 8.0                  | 106                     | 6.2                 |
| <i>Pelvetia canaliculata</i> | 4.9                  | 115                     | 3.6                 |
| <i>Fucus vesiculosus</i>     | 2.6                  | 114                     | 1.9                 |
| <i>Laminaria digitata</i>    | 0.3                  | 123                     | 0.16                |

The figures in all cases are calculated on oven-dry material.



Analysis of the extracts was confined to a separation of the unsaponifiable residue and fatty acids and the determination of their iodine values. The unsaponifiable residue, calculated as a percentage of the petrol ether extract, was found to increase with depth of immersion as follows

|                        | Unsaponifiable Residue |                    | Iodine Value of Unsaponifiable Residue |
|------------------------|------------------------|--------------------|----------------------------------------|
|                        | Percentage of Extract  | Percentage of Weed |                                        |
| <i>P. libera</i>       | 7.6                    | 0.61               | 124                                    |
| <i>P. canaliculata</i> | 10.8                   | 0.53               | 117                                    |
| <i>F. vesiculosus</i>  | 16.9                   | 0.44               | 136                                    |
| <i>L. digitata</i>     | 25.9                   | 0.078              | 125                                    |

It will be seen, however, that the iodine value, as determined by the pyridine bromine method, shows no regularity. The percentages of fatty acids, calculated on the petrol ether extract, together with the iodine values of the acids, are given in the following table

|                        | Percentage of Fatty Acid | Iodine Value |
|------------------------|--------------------------|--------------|
| <i>P. libera</i>       | 72.5                     | 107          |
| <i>P. canaliculata</i> | 69.9                     | 124          |
| <i>F. vesiculosus</i>  | 71.6                     | 108          |
| <i>L. digitata</i>     | 49.9                     | 110          |

It should be noted that the fatty acids when isolated tend to reduce their iodine value on exposure to air, and although evaporations were carried out *in vacuo*, a certain amount of exposure was inevitable, and consequently the values given above may be somewhat low. A further separation of the fatty acids into solid and liquid acids was carried out in the case of two sea-weeds representing the extremes of habitat, and the results, calculated as percentages of the total fatty acids, are as follows

|                    | Solid Acids | Liquid Acids |
|--------------------|-------------|--------------|
| <i>P. libera</i>   | 11.5        | 78.7         |
| <i>L. digitata</i> | 17.7        | 72.2         |

It appears from the foregoing that, while the general character of the fats is about the same, there is a distinct difference in the proportion of unsaponifiable residue and in the absolute amounts of fat in these sea-weeds

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March 29

<sup>1</sup> Haas and Hill, *Brochem J.*, 23, 1000, 1929

<sup>2</sup> Haas and Hill, *Brochem J.*, 25, 1472, 1931

#### Light as a Factor in Sexual Periodicity

I OBSERVE with interest the letters of Dr M. A. H. Tincker and Mr J. T. Cunningham<sup>1</sup>. In regard to the former, I should like to point out that some observations on the periodicity of plankton diatoms have been made. Only in lakes with a relatively high percentage of dissolved salts do diatoms attain great maxima, and vast maxima have only been found to occur in a few British lakes. Many plankton diatoms occur in the greatest quantity in spring, that is, are reproducing at the fastest rate, but some attain their maxima in summer and autumn. A remarkable fact is that some forms have a double maximum, one in spring and one in autumn. In Lake Windermere the following are known to exhibit this phenomenon

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*Asterionella gracillima*, *Rhizosolenia morsa*, and others. The maxima in the spring may be explained by light influencing reproduction, whereas other maxima may be due to differences in temperature and percentage of dissolved salts. Although a difficult task, observation of diatom and plankton maxima in the ocean might lead to interesting results.

Diatoms, of course, must be under the influence of the sun's light and heat to be able to continue their nutritive functions, and so maintain life within the cell. Sunlight is, therefore, a necessity for nutrition, but this is not the case where reproduction is concerned, for it is a notable fact that cell-division (the usual method of reproduction) generally occurs at night. From this it appears that diatom reproduction is probably influenced by the lunar factor, mentioned in Mr Cunningham's letter. If this is so, it would be of great interest to place a culture of diatoms at the optimum temperature in polarised light. Observations of the effect on their cycle of reproduction, and on their prolificacy under these conditions, should prove a very useful piece of research work.

GRAHAM PHILIP

128 Westbourne Avenue,  
Hull, April 9

<sup>1</sup> NATURE, 129, 543, April 9, 1932

#### Climate and Parent Material in Soil Formation in South-West England

STUDIES of the profiles of soils in central Somerset have shown that typical podsoles are developed on sands, whilst on the Lower Lias limestones and clays adjoining, the profiles are typical of the 'brown earths' described by Ramann<sup>1</sup>. The podsoles are developed on recent deposits—Burtle Beds—and show very clear demarcation into bleached layer and layer of accumulation. The formation from these recent deposits gives us a maximum time for the formation of these podsoles.

Whether podsoles would ever develop on the clays and limestones of the Lower Lias it is difficult to say, because of the disappearance of all the old forest, but they are not found on the present woodland, which may represent the remains of the indigenous forest.

These observations suggest that the climate is such that podsoles would develop with suitable parent material, but on the limestones and clays of the Lower Lias, the parent material is a dominant factor in the soil-forming processes on these deposits in south-west England, the climatic factor being recessive.

A. JAMES LOW

South-Eastern Agricultural College,  
Wye, Kent, March 23

<sup>1</sup> "The Evolution and Classification of Soils", Ramann

#### Protection of Herbarium Specimens

THE letter from Messrs F. K. Jackson and R. L. M. Ghose<sup>1</sup> on the protection of herbarium specimens makes a valuable suggestion. Perhaps I may be permitted to refer readers and others interested in the subject to a paper on the "Preservation of Herbarium Specimens and Insects on Celluloid", by Mr John Ritchie, of the Perth Museum, published in the *Museums Journal* for May 1930. If Mr Ritchie's method of mounting on a transparent sheet of celluloid were combined with the cellophane covering employed by your correspondents, the plant would not only be protected, but would also be visible from both sides.

F. A. BATHER

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<sup>1</sup> NATURE, 129, 402, March 12, 1932

## Research Items

**The Lime, Rice-Straw, and Convolvulus in India**—Magical and other practices in India in which the lime rice-straw, and the convolvulus play a part are discussed by Mr R. E. Enthoven in *Folklore*, vol 43, pt 1. It is customary for village officials to offer two or three limes to a British official when he visits their district. This is more than a compliment, it is a widespread use in driving away evil influences. A lime stuck on the end of a knife is a well-known spirit-scarrer. Recently its use in connexion with the Bombay rite of *muh mārana* has been noted. The exorcist prepares an image of wheat flour and worships it. A lime pierced by a number of thorns or pins is placed before it, and as water mixed with molasses is poured over the face of the image, the lime gradually fades away. It goes to the man whom it is desired to kill and strikes him in the chest. He falls to the ground vomiting blood. In the Central Provinces, it has been noted of late by police officials investigating cases of suspicious death, that a lime is frequently found by the body, especially where poison is suspected. Rice-straw tied in a bundle to an object, in the Rathnagiri district, prevents interference with it when it is the subject of a legal dispute. From this spell release can be obtained only by an appeal to the deity, who must grant a sign of his decision on the matter. The interest of the convolvulus lies in the fact of its close connexion with certain of the castes of the Deccan and Konkan. Although they differ in occupation and widely in social status, these castes have the convolvulus as their common *devak*, that is, an object of worship, which they must protect. It is a bar to marriage between all members of these castes.

**West Indian Prehistoric Pottery**—A study of the prehistoric aboriginal pottery of the Dominican Republic, Haiti (*Bull* 156, *U S National Museum*), by Mr Herbert W. Krieger, is based largely on examples collected from sites excavated during expeditions to the island in 1928, 1929, and 1930. It was found that variation in decorative design, form, and style was much greater than had been anticipated. Forms and designs, which appeared to be examples of ready-made borrowing, proved to be parts of series linking up with characteristic Taino designs of the Santo Domingo-Porto Rican pottery area. This, in turn, was found to extend well beyond the limits of the two islands, and to link up on the south with lowland forest areas of South America, and on the north with the margin of the eastern Indian pottery area, including the Iroquois of eastern Canada and the contiguous United States. Other designs occur in representative collections from the Upper Mississippi Valley, from the Gulf States of the south-east, and from the Florida Peninsula. This, however, does not imply cultural diffusion or conscious copying, but rather a marginal position in relation to some eastern pottery-producing centre. The entire Mexican, Middle American, lowland and highland South American pottery-producing areas share a common heritage in a culture complex which centres around the cultivation of maize, cassava, and other roots, with which is associated pottery-making. The development of the elements in pottery-making is determined by local environmental differences, physical and spiritual. Thus, for example, in Santo Domingo, the modelling and application of clay figurines, distinctive of decorative design in Middle American tribes, is further differentiated by the absence or presence in representation of certain reptiles and mammals, absent or present in the fauna of that area.

**Individuality of Chromosomes**—During the interphase of nuclear division, the chromosomes usually lose their visible identity, but considerable evidence suggests that they do retain some kind of individuality during this period. It is, however, not clear exactly how we should apply the term individuality. Does it apply only to the chromatic material or should it include the achromatic substratum as well? Bearing on this question, Grégoire (*Bull. Roy. Acad. Sci. Brussels*, 17, 1435-1448) has published an interesting note on some work carried out by one of his students on nuclei of *Impatiens Balsamine*, in which type prochromosomes or euchromocentres are characteristic features of the interphase nuclei. In number, these chromatic bodies are equal to or fewer than the specific chromosome number and occur close to the nuclear membrane, and it is an interesting new point that each one already shows the constriction or point at which the chromosomes will afterwards become attached to the spindle fibres. Another new observation is that during early prophase, bands of achromatic material gradually become evident as prolongations of the euchromocentres. This suggests that not only does the central part of the chromosome persist through interphase as the euchromocentre, but also that this is associated with a definite region of achromatic material which condenses again during prophase into the chromosomes. Though these observations are specific, the uniformity of nuclear behaviour is such that a point definitely shown for types with euchromocentres will in all probability be applicable also in general principle to types with a more uniform nuclear reticulum in the interphase.

**Leaf Curl Disease of Cotton**—A recent paper upon "The Leaf Curl Disease of Cotton in the Sudan" (*Empire Cotton Grow. Rev.*, vol 9, no 1, Jan 1932, pp 32-45), by R. E. Massey and F. W. Andrews, describes a malady of cotton which appears to have general relations with a plant virus disease. The authors correctly use the term 'virus' very infrequently in their paper, as they have no evidence for the ultra-microscopic nature of the causal agent. Their work is nevertheless extensive, and detailed descriptions of symptoms, both external and histological, are given, with descriptions of transmission by insects, grafting, and juice inoculations. It is interesting to note that the lamina of a diseased leaf is more than three times as thick as that of a healthy leaf. The insect vector is apparently an aleurodid, and seems to be an efficient transmitting agent. Grafting is the only other successful method of transfer, for juice inoculations have proved unsuccessful. Chemical examination of healthy and diseased leaves showed no difference in the amounts of starch, pentosans and nitrogen, but revealed a striking increase in diastatic activity in diseased tissue. The curl disease reduces the number of bolls per plant, and so would seem to be of considerable economic importance.

**Meteorological Tables**—The Smithsonian Meteorological Tables, that fill an entire volume of the Smithsonian Miscellaneous Collections (vol 86 in the case of the revised edition under review), are of importance for all serious students and advanced workers in meteorology. These tables were badly in need of revision, the dates of previous editions were 1893, 1896, 1897, 1907, and 1918, and the long interval since 1918 has seen a rapid development of meteorological theory. In an abstract dealing with the new

edition issued by the Smithsonian Institution attention is directed to the more important features that appear for the first time. These include comparisons between sunlight, moonlight, and starlight, standards for the duration of astronomical and civil twilight, comparisons between linear metres and the dynamic metres of V. Bjerknes for variations of gravity with varying latitude and altitude, and tables for the determination of height by observation of the temperature of boiling water. The simpler conversion tables, such as inches to millibars, have not been crowded out. English meteorologists will be grateful for the inclusion of hygrometrical tables appropriate to British wet bulb thermometry. Another particularly useful item, and one not normally included in British publications, is the detailed relationship between the zenith distance of the sun and the mass of air traversed by the sun's rays in reaching the earth's surface. One serious omission may be noted. There are no tables relating to the calculation of the entropy, potential temperature, or pseudo-potential temperature of the air under different conditions of pressure and temperature. The preparation of these tables was done under the direction of C. F. Marvin, chief of the U.S. Weather Bureau, assisted by H. H. Kimball, senior meteorologist of that bureau.

**A Simple Thermo-electric Pile**—M. Jean Gabreau has described the method used on the Chemin de Fer du Nord to notify at a distant cabin the failure of the light on a signal-post (*Bull. Soc. d'Encourag. l'Indust. nat.*, January). It is based on the action of a thermopile which is placed in the lantern above the flame in such a way that the hot air from the flame surrounds one set of junctions while the other set is exposed to the air outside the lantern. The current produced operates a relay in the cabin, which shows a red light and rings a bell when the thermocurrent fails. The thermopiles, which have been in use since 1926, are made by winding forty turns of 0.2 mm. constantan wire around a sheet of mica with notched edges. The wire on one side of the sheet is then varnished and the sheet immersed in acid until the wire on the other side is reduced to half its original section. A thin layer of copper and over it a thicker one of silver, which brings up the section to its original value, are deposited electrolytically. After dissolving the varnish, the whole wire receives a thin deposit of platinum. In action the pile gives an electromotive force of about 400 millivolts, and a current of 4 to 5 milliamperes.

**Infra-Red Photography of Aurora**—Supplementing his communication to NATURE of March 26 on spectrographic observations of infra-red lines in the auroral spectrum, Prof. L. Vegard informs us that Dr. Bauer, working on cinematographic exposures of northlight at the Auroral Observatory at Tromsø, succeeded in January of this year in obtaining a picture of an aurora with infra-red filter and plates sensitive to infra-red rays.

**Cosmic Rays**—Some investigations on the cosmic rays, reported in the first February number of the *Physical Review*, are of particular interest at present in view of the possibility that these may be identical with neutrons. One by H. L. Mott-Smith confirms the failure of other investigators to deflect the rays by magnetic fields, a fine technique has been developed for this piece of work, which includes the preparation of sealed Geiger-Müller counters by good vacuum methods, a refinement which has been repaid by the reliability of the instruments. The main result of the two others, which are by R. A. Millikan,

is that the ionisation of the air by cosmic rays is more intense than had been supposed, the rate of formation of ions at sea-level under standard conditions is now given as almost 2.5 per c.c. per second instead of about three-fifths of this. Prof. Millikan has also found that the sun has no direct influence on cosmic ray intensities, to within about  $\frac{1}{3}$  per cent of the total ionisation, and has shown incidentally that there is an interesting source of error in connexion with the use of electrosopes containing gas at high pressure for precision work, arising from the effect of temperature on the rate of recombination of ions.

**Elements 85 and 87**—Allison, Bishop, Sommer, and Christensen (*J. Amer. Chem. Soc.*, Feb.) describe experiments with a magneto-optical method, depending on the time lag differences of the Faraday effect behind the magnetic field, on solutions of minerals. In solutions of pollucite and lepidolite, minima were observed which cannot be due to tin and rhenium compounds, and are attributed to element 87. This is also stated to exist in sea water, Searles Lake brine, Stassfurt kainite, crude caesium chloride, monazite sand, and samarskite. Six minima are considered to indicate the probable existence of six isotopes of element 87. Element 85, present only in very small amounts, was detected in solutions of Brazilian monazite sand, from 100 lb. of which indications of  $2.5 \times 10^{-6}$  gm. of the lithium compound of 85 were obtained. The name alabamine (Am) is proposed for the element, and the solutions are supposed to contain salts of the acids  $\text{HAmO}_4$  and  $\text{HAm}$ . The atomic weight of alabamine is estimated to be 221. The peralabamic acid is more stable than other oxy-acids of the element which are indicated in the solutions after appropriate treatment.

**Intermetallic Compounds formed in Mercury**—A. S. Russell, with Cazalet, Irwin, and Lyons (*J. Chem. Soc.*, March) describes the formation in mercury of several stable compounds of the metals copper, tin, zinc, and iron produced by shaking the metals with mercury. These differ from the constituent metals in being insoluble in mercury and generally in reducing power. It was necessary to devise analytical methods for determining their empirical formulæ without removing them from the mercury in which they were suspended, and these methods are described. Some of the compounds are ternary, mercury being one constituent, and their formulæ are very varied, but the total numbers of valency electrons are 6, 9, or 12, or a simple multiple of these numbers. Iron does not form a compound with mercury, yet its action towards reducing agents in presence of mercury resembles closely that of copper, although the passivity does not depend on metallic compound formation. Many of the binary intermetallic compounds have not previously been reported.

**The Glow of Phosphorus**—The *Collection of Czechoslovak Chemical Communications* for March contains an account of the influence of chlorine and bromine on the glow of phosphorus by Krejčí and Schacherl. The inhibiting effect of these halogens on the glow had been previously noted, and the case of chlorine studied in detail by Bowen and Cavell in 1929. The present authors took special precautions to ensure the purity of the materials, the chlorine, for example, being obtained by the electrolysis of fused pure silver chloride. The pressure in the apparatus was followed by a Bodenstein quartz manometer, the effect on the glow in air and oxygen at temperatures of 15°, 20°, and 25° C. being investigated. Both halogens show a poisoning effect, which is

stronger in oxygen than in air. They are more effective than ethylene but weaker than propylene, whilst nitrogen dioxide, previously investigated, is about ten times as efficient as either. The results could be represented by the equation already used for nitrogen dioxide, namely,  $p = k/(a + x)$ , where  $x$  is pressure of halogen/pressure of oxygen,  $p$  is the maximum pressure of the glow, and  $a$  and  $k$  are constants. Dry gases were used. The effect can be explained on the assumption that chlorine breaks reaction chains by forming chlorine monoxide with atomic oxygen.

**Deterioration of Structures in Sea Water**—The Committee of the Institution of Civil Engineers which is investigating the deterioration of structures of metal, timber, and concrete in sea water, began its work in 1916 and published its first report in 1920. Interim Reports have been issued annually since then, and the twelfth of the series reviews the work done in 1930–31 (London: H.M. Stationery Office, 6d net). The specimens under observation are exposed in many parts of the world—Nova Scotia, Ceylon, Australia, New Zealand, Kenya Colony, the Gold Coast, etc.—and the materials exposed include many varieties of iron and steel, many kinds of timber, and specimens of ferroconcrete. Of the various irons and steels under observation, those with the highest percentage of nickel and chromium appear to give the best results. The investigations of the Committee on methods of protecting timber against marine borers have been continued with the assistance of Profs G. Barger and S. M. Dixon, and in his report Prof. Barger gives the results obtained through impregnating timber with creosote, fuel oil, arsenical poisons, naphthalene, or tar acids. Prof. Dixon, in a further report, gives some interesting figures showing the effects of incising timber before impregnation. A block of Oregon pine (Douglas fir), 10 in.  $\times$  6 in.  $\times$  2 ft., with incisions

spaced  $\frac{1}{2}$  in. apart in rows round the periphery absorbed two to three times as much creosote as a similar unincised block.

**Breaking Circuits and Clearing Faults on Large Networks**—The modern methods of linking together isolated electric distribution networks has given rise to problems in mathematics and physics, partial solutions of which are now being obtained. All the component networks are linked into a single network, every part of which responds to changes in every other part. The large amount of generating plant working in parallel distributed over a wide area, and its haphazard distribution, have introduced problems which do not occur in small networks. In a paper read to the Institution of Electrical Engineers on March 17, R. O. Kapp and C. G. Carrothers discuss from the mathematical point of view the design of systems to protect the network when a fault occurs. It is suggested that the fluctuations in the currents caused by a fault might be used to work the relays employed for the automatic isolation of a faulty portion of the network. At the same meeting H. Pearce and T. T. Evans read a paper on the design and performance of oil circuit-breakers, that is, switches which break the electric circuit under oil. The irregularity in the performance of these devices is generally considered to be due to the erratic movement of the oil. For the higher voltages, quick-break apparatus is considered advantageous. By suitably designing the two contacts with a shroud, improved and consistent results are obtained. The importance of short circuit testing is emphasised, and a plea is made for facilities for testing on the site. A description is given of the oscillograph equipment necessary for testing on the site, and reports of recent tests carried out on oil circuit-breakers fitted with a new type of shrouded contact are added.

## Astronomical Topics

**Parallaxes of Faint Stars**—Study of pairs of photographs taken at intervals of several years have revealed many examples of very faint stars with fairly rapid proper motions. *Mount Wilson Contributions*, No. 435, contains a paper by A. Van Maanen on an investigation of the parallaxes of some of these stars from photographs taken with the 100-inch and 60-inch reflectors. The largest parallax on the list is that of B.D. 43°4305, for which the value 0.209" was found. That star had, however, already been measured elsewhere. Another large parallax is that of Ross 41, mag. 13.4, parallax 0.110". Altogether there are 15 stars on the published list that have absolute magnitude fainter than 10.0. The faintest is a star lately found by Hubble to have a proper motion of more than 1", its absolute magnitude is 14.0. The fact that such a large number of extreme dwarfs are found comparatively near the sun shows that this type of star must really be very common in space, but they are too faint for observation unless their distance is small.

**Astronomical Notes for May**—Venus continues to be a brilliant object, reaching its greatest brilliance on May 22, the illuminated fraction of the disc diminishes during the month from  $\frac{1}{2}$  to  $\frac{1}{4}$ , it is near the moon at 5 P.M. on May 9.

Jupiter passes quadrature with the sun, and is still observable for half the night. Satellites I and II and their shadows are both on the disc on the evening of May 5, I and IV are simultaneously in eclipse late on the evening of May 20, there is a partial eclipse

of III by the shadow of II on May 4 from 11.16 to 11.38 P.M.

Saturn can be observed late in the night, but its south declination of 19° renders the conditions difficult.

$\alpha$  Virginis is occulted by the moon at 8.5 P.M. on May 17, it is the only occultation visible in London before midnight.

Two comets may be visible with moderate telescopes, the following ephemeris of Houghton's comet for 0<sup>h</sup> is by Drs. Cunningham and Whipple, an ephemeris given earlier proved to be erroneous.

|       | R.A.                                            | Decl.     |
|-------|-------------------------------------------------|-----------|
| May 1 | 12 <sup>h</sup> 42 <sup>m</sup> 48 <sup>s</sup> | S 15° 20' |
| " 5   | 12 42 19                                        | 8 3       |
| " 9   | 12 42 30                                        | S 2 2     |
| " 13  | 12 43 13                                        | N 2 51    |
| " 17  | 12 44 25                                        | N 6 47    |

The following ephemeris of comet Grigg-Skjellerup is from *B.A.A. Circular* 113.

|        | R.A.                                           | N Decl. |
|--------|------------------------------------------------|---------|
| May 15 | 7 <sup>h</sup> 54 <sup>m</sup> 12 <sup>s</sup> | 20° 23' |
| " 20   | 8 20 20                                        | 26 0    |
| " 25   | 8 53 28                                        | 32 32   |
| " 30   | 9 37 24                                        | 39 39   |

Ephemerides of three other periodic comets, Neujmin (2), Kopff, and Borrelly, are given in the *B.A.A. Handbook for 1932*, all are likely to be near the tabular positions, the search for them will be most conveniently made by photography.

The times given above are Greenwich Mean Time; 1 hr. should be added to give Summer Time.

## Physiological Studies of Single Plant Cells

PHYSIOLOGISTS will welcome a summary ("Physiological Studies of Single Plant Cells", by W J V Osterhout, *Biological Reviews*, vol 6, pp 369-411) of the extensive literature on the algae *Valonia* and *Nitella* by one who has been so intimately associated with this work. The bibliography is a formidable one comprising 227 citations. The data obtained by three types of experimental procedure, namely, (1) chemical analysis, (2) measurement of potential differences at various boundary surfaces by the use of single cells suitably arranged to procure the desired electrical circuit, (3) measurement of electrical resistance or capacitance, are discussed.

The review is itself so condensed that any further summary of it would be impracticable. The electrical experiments are interpreted as supporting the idea that the external cell surfaces are non-aqueous in nature, of high resistance, and permitting little dissociation of salts. The relative order of the mobilities of ions in protoplasm (unlike the case of collodion) does not resemble that obtained for salts in water, but rather that for certain non-aqueous solvents. In spite of the discussion and the literature cited there will still be, no doubt, those who find it difficult to conclude that some of the theories advanced materially clarify the vexed question of the accumulation of electrolytes by living cells. It is a question whether (for example, in the case of the accumulation of KCl) the facts warrant the more complicated assumption that accumulation of KCl involves penetration of undissociated KOH, the energy necessary being furnished by metabolism with the liberation of an organic acid HA which is then exchanged for HCl of the external solution (see p 377), rather than the simple statement that KCl accumulates against a concentration gradient, the energy necessary being

supplied by metabolism. In this connexion the comprehensive experiments of Hoagland and Davis receive but incidental citation.

It seems curious that, whilst in certain connexions stress is laid upon the importance of the energy released by the cell and that salt accumulation is not a physico-chemical equilibrium, the multiple partition theory of Irwin should receive such favourable discussion, whilst the mathematical treatment seems to evade such energy supply and to involve mainly operations based on equilibria. It is possible that some of the interpretations of accumulation which apply solely to electrolytes, and not at all to non-electrolytes, may be premature, whilst the view that the cell has at its disposal a source of energy which may produce accumulation of both electrolytes and non-electrolytes seems to have been rather lightly dismissed, though it has figured somewhat prominently in other writings upon *Nitella*.

Many will reiterate one of the concluding remarks: "But mere complexity should not baffle the analytical resources of modern science if all the variables can be measured. The greatest difficulty is that in attempting measurements we may change variables or create new ones without being aware of it." The necessarily scanty attention paid to experimental technique in so brief a review covering so wide a field leaves one unable to say to what extent many of the experiments were affected by such uncontrolled variables. In particular, the effect of the often arbitrary technique adopted on two of the most important variables when dealing with respiring plant cells, namely, the oxygen and carbon dioxide concentrations in the environment, with its consequent effect on metabolism and any processes determined by metabolism, remains difficult for the reader to evaluate.

## Meteorology of the Persian Gulf and Mekran

UNTIL after an international aerial route had been established along the Persian coast, meteorological information for this region was very scanty; the systematic study of its climate rested mainly upon a few observing stations, making observations once a day only, which had been established by the India Meteorological Department. A more elaborate organisation arose in 1927, in response to the needs of aviation, which took the form of a chain of telegraphic reporting stations extending from Karachi to Bushire and observing at 4 A.M. and 2 P.M. G.M.T., that is to say, at about 8 A.M. and 6 P.M. local mean time.

The records obtained in this way allowed of the construction of synoptic weather charts on modern lines, each station, moreover, kept a diary of phenomena occurring in disturbed weather. It is usually considered necessary to have records over a long period of years for any region before attempting to discuss its climate. To obtain reliable 'normal' values for the different climatic elements, this is a real necessity, but a careful perusal of Dr Banerji's recent publication\* suggests that he has done a useful service by presenting a preliminary study, which appears to give the salient climatic features of an interesting region, and connects these with meteorological events over a wide region extending to the Asiatic 'centre of action' in the north and to the

south-east trade-winds of the southern part of the Indian Ocean.

As would be expected from geographical considerations, the climate of Mekran and the Persian Gulf has many points of resemblance with the better known climates of north-west India. There is a winter regime and a summer regime, and the differences between the two greatly transcend those that must inevitably arise through seasonal variations in the amount of solar radiation and in the length of the day. The explanation obviously lies in the disturbance set up by the great seasonal change of pressure over Asia, and by the invasion of the Indian area in summer by diverted south-east trades from beyond the equator, that cause the Indian 'rams'.

In winter, the Asiatic area of high pressure tends to show an extension south-westwards to Persia, but the fine and dry weather that might result from this is interrupted by the eastward passage of depressions known to Indian meteorologists as 'western depressions'. About eight of these occur on an average in a winter month. Dr Banerji found, as a result of a careful analysis of his synoptic charts, that these are generally the remains of depressions that have passed out of the eastern Mediterranean, or secondary disturbances connected with them, such as are frequently found to occur when a depression crosses mountainous regions or is nearing the end of its life-history. Their behaviour and mode of formation are considered by him to conform with Norwegian views as to the origin of the depressions of temperate latitudes.

\* India Meteorological Department. *Meteorology of the Persian Gulf and Mekran*. By Dr B N Banerji. Pp. iii+65+9 plates. (Calcutta: Government of India Central Publication Branch, 1931.) 3 rupees, 5s. 3d.

All the phenomena of the warm and cold 'front' and of the 'warm sector' are observed. In the cold front, the phenomenon of the line-squall, with or without thunderstorms, is often well developed, and is a danger to aerial navigation, for the northerly or north-westerly wind may arise with the force of a gale. There is little doubt that the outflow of cold air from the Siberian high-pressure area tends, owing to the general configuration of the land around the Persian Gulf, to take a north-west to south-east trend from Iraq, and it readily concentrates into a violent intruding wave of polar air behind a depression. An analogous effect is to be observed in the lower reaches of the Rhone valley, where we have the violent 'mistral'. As the western depressions of the Persian Gulf often advance from regions lacking in meteorological reporting stations, the onset of the dangerous cold front squalls can only be anticipated well in advance from the other frontal phenomena and pressure changes that normally precede it, which does not allow of accurate anticipation of the time of its arrival. Owing, however, to the fact that the ocean swell to which it gives rise travels more rapidly than the front itself, an 'eleventh hour' warning of a much more definite kind is obtained from the arrival in suitable circumstances of such a swell.

In summer, conditions are more complex and less definite. The Asiatic low-pressure system has a local extension south-westwards to Arabia, and variations in the intensity and position of the centre of this extension, which is often to be found over the south-east of Arabia, are liable to cause big changes of wind and weather over the Gulf and Mekran. When the local centre retreats to Persia or north-west India, north-westerly winds tend to invade the whole region, and may reach the force of a gale, but they

will do so only gradually, and violent frontal squalls need not be feared at this season. At the height of the monsoon, when south-west winds have advanced across the Arabian Sea so as to penetrate Persia and Baluchistan, depressions may travel into those countries and winds from south-west or west may extend from Mekran over at least a part of the Gulf. Occasionally also depressions moving westwards from the Bay of Bengal affect this area. More often at this season there is a cyclonic circulation around the south-east of Arabia, the wind being southerly to easterly in Mekran and north-westerly in the Gulf.

Between the winter and summer regimes there are transitional periods, when, apart from local thunderstorms, dust storms, and other disturbances of convectional character, the weather is for the most part fine and quiet.

The effects of the various seasonal tendencies, outlined above, can be traced in the climatic tables towards the end of the work, and some individual storms are illustrated by synoptic charts and records of autographic instruments. Apart from its practical importance for flying, the work links up the better known climates of north-west India, Mesopotamia, and Upper Egypt in an instructive manner. Considered simply as climate, the heat and small amount of cloud revealed by the tables are the outstanding features of this region. Shade temperatures above 90° begin to appear so early as February, and 100° is often exceeded from March to October. In July, nearly all the stations have a mean night minimum above 80°, while at Bushire it averages 87°. Within the short period under review, 112° has been attained in more than one place. It must not be supposed that dry healthy heat is the rule, for, at the entrance to the Gulf, the wet bulb thermometer averages 85° in July.

E. V. N.

### The Origin of 'Mare Sporco'

MASSES of a yellowish or greenish-brown gelatinous substance floating at the surface of the sea and at times colouring large areas are the cause of the phenomenon known as 'mare sporco'. It is especially noticeable in the Adriatic, but may occur also in many other places. Numerous authorities have written on the subject, and Dr Vito Zanon has reviewed the literature in the paper before us ("Esame di un campione di 'Mare Sporco' del Golfo di Fiume" *Memorie della Pont. Accademia delle scienze—i nuovi Lincei* Series 2, vol 15 1931). His conclusions, based on his own observations, show that these curious masses in the water have their origin at the bottom where innumerable diatoms, usually a few definite bottom-living species, in certain circumstances by rapid reproduction give rise to a large amount of a gelatinous substance impregnated with much oxygen.

When the water is warm the bubbles of gas swell and the gelatinous masses, which are full of diatoms, and with them a good deal of oozy mud, rise to the surface, causing the water to appear a dirty yellowish or greenish colour. When it is colder, or when storms, winds, and waves are in action, the masses are scattered and descend again to the bottom. Great inconveni-

ence is caused to the fishing nets, as the masses clog the meshes and sometimes break them with their weight. This condition may last a fortnight, during which time fishing may have to be abandoned.

The special sample from the Gulf of Fiume examined by Dr Zanon was made up chiefly of the diatoms *Nitzschia Lorenziana* var. *subtilis* Gran, *Pleurosigma lineare* Gran, and probably *Nitzschia sigmoides* W. Sm., but different diatoms may be the cause in other parts. Some authors found dinoflagellates and various planktonic forms. These, however, may have become entangled in the floating gelatinous mass and may not be its original cause. Schreiber found chiefly the diatom *Bacillaria paradoxa*, which lives epiphytically on *Zostera*, in the masses from the waters around Venice.

Dr Zanon shows clearly that the phenomenon is not identical with those efflorescences in the sea which among many names given to them are known as 'red water' or 'yellow water'. These are caused by an enormous outburst of growth of certain planktonic organisms. The true 'mare sporco' is definitely caused by bottom diatoms in gelatinous masses, rising to the surface in the warmth and descending in the cold.

### Ceremonial Games and Social Organisation among the Creek Indians

MR JOHN R. SWANTON during the summer of 1929 visited the Creek country with the view of obtaining further information relating to the 'square grounds' or sacred areas in which the Creek Indians celebrate their busks and other annual ceremonies. His report is now published in *Smithsonian*

*Miscellaneous Collections*, vol 85, No 8. The 'square grounds' are intimately connected with Creek ceremonial, social and political organisation. According to tradition, after the formation of the Creek confederacy, the Kasihta and Coweta, the two divisions of the Muskogee element in the Lower Creeks, who



lived on the river, now the boundary between Alabama and Georgia, having defeated all their enemies, instituted periodical ball-games as a kind of moral equivalent for war. As friendly relations were established with other Indians and they were admitted to the confederacy, they joined with one side or the other and the dual system became general, the Kasihta becoming known as the 'white' side and the Coweta as the 'red'.

In the ceremonial games four towns played on either side. There was a certain aloofness of the towns of one moiety from those of the other. They did not intermarry. The people of each town were divided into clans, each with an animal name, and certain of these clans were linked into phratries which, in theory at least, were exogamous. A further division links them as 'white' people and 'people of a different speech'. These are also said to be exogamous, but the principal function of this division seems to be to determine on which side the people should play in the town games.

Every town has a ceremonial ground in which there are three elements: a community hot-house, used in bad weather and for secret ceremonies, a 'square ground', and a 'chunky yard', so called from an old pastime which consisted in rolling a disc along a level plot and throwing poles at it. In the centre of this yard is a single pole with a cow, a horse skull, or a wooden figure on it. Around this the men and women play a kind of ball-game.

In the ceremonial games, which resemble our lacrosse, and are solemn affairs, only the men play. On the 'square ground' are performed the 'stomp-dances', of which three or four take place in the spring and early summer. Only members of the town take part. They lead up to the great annual ritual, lasting four days, in which prominent features are the woman's dance and the fast and ceremonial bath of the men. This is a ceremony by which the Creeks clearly believe that they return to the state of harmony with the spirit of Nature which has been ruptured by the profane acts of the preceding year.

### University and Educational Intelligence

CAMBRIDGE—An appointment is to be made this year to a Busk studentship in aeronautics. The studentship is of the value of about £150, tenable for one year, and is open to any man or woman being a British subject and of British descent who has not attained the age of twenty-five years on Oct. 1 next. Forms of application for the studentship can be obtained from Prof. B. Melville Jones, Engineering Laboratory, Cambridge, and must be filled up and returned to him not later than May 12.

Prof. Albert Einstein will deliver the lecture on Mr. Rouse Ball's Foundation on Friday, May 6, at noon. The subject of the lecture will be "Die Theorie der Elektrizität im Rahmen der allgemeinen Relativitätstheorie."

LONDON—Applications are invited for the Bayliss-Stirling Memorial Scholarship (value about £120 per annum and exemption from tuition fees) at University College. The successful candidate will be required to follow a course of study approved by the Jodrell professor of physiology and involving a training in the principle of and methods of research in physiology and biochemistry. Applications must be received not later than May 14 by the Secretary, University College, Gower Street, W.C.1.

MANCHESTER—The Manchester City Council is again offering a number of scholarships tenable in the Faculty of Technology of the University. Suc-

cessful candidates are required to follow a full-time course leading to the degree of bachelor of technical science in the College of Technology, and matriculation or its equivalent is an essential qualification. For students who have been engaged in industry, and who have attended part-time day or evening classes, the scholarships are of the value of £100 a year, while for students leaving secondary or central schools the value is £60.

### Calendar of Geographical Exploration

#### May 1, 1607—Hudson's Voyages

Henry Hudson left Gravesend on his first voyage of arctic exploration, hoping that it might be possible to find a passage right across the polar area. He sighted the east coast of Greenland north of any previous point reached, and by following the ice barrier which extends between Greenland and Spitzbergen, proved that there was little chance of finding a passage through. On a second voyage he reached Novaya Zemlya and made several landings, but failed to penetrate to the Kara Sea. In his next voyage (1609), the ice proving unfavourable for the Novaya Zemlya region, he decided to search for a passage on the American coast, and there discovered the Hudson river. In 1610 he set out in the *Discovery* and passed through Hudson Strait to Hudson Bay. In the latter the ship was frozen in, and the party passed the winter in great distress and scarcity of food. A mutiny broke out, and Hudson and those who supported him were put in an open boat and left to their fate, the mutineers sailing home in the *Discovery*. The strait and bay named after him were probably known to the Portuguese in the second half of the sixteenth century, and Frobisher and Davis also visited the strait.

#### May 1, 1769—Opening up Kentucky

Daniel Boone, a typical backwoodsman, keen on hunting and exploration, left his home in North Carolina, crossed the Alleghenies and the Cumberland Mountains, and reached the fertile but forest-clad plain of Kentucky. He was captured by Indians, but made his escape, and later settled with his family in the region, which was soon visited by other surveying parties.

#### May 2, 1497—John Cabot

The *Matthew*, commanded by John Cabot, a Genoese who became a naturalised citizen of Venice and later settled in England, sailed from Bristol. With a crew of 18 he crossed the North Atlantic and discovered land thought by some to be Cape Breton Island, by others to be southern Labrador or Newfoundland or Nova Scotia. In any event, Cabot did not realise that he had approached the shores of America, but thought that the land was part of the coast of north-east Asia. His son, Sebastian, after sailing in a Spanish expedition from Seville which reached the river La Plata in 1527, returned to England. He afterwards became director of the Company of Merchant Venturers, incorporated on Dec. 18, 1551, and in that capacity helped to organise the expedition of Willoughby and Chancellor.

#### May 3, 1850—Sledge Travel in the Arctic

Capt. H. Austin sailed with two ships to search for Sir John Franklin via the Barrow Strait. Austin and Penny, a whaling captain, entered Barrow Strait and discovered Franklin's winter quarters of 1845-46, but no record of the direction taken by the ships. Austin and McClintock advanced to Melville Island, marching more than 770 miles in 80 days. Austin also examined the entrance to Jones Sound. The expedition is

notable for the excellent way in which M'Clintock conducted the sledge travelling. M'Clintock went out again with Kellet's expedition, which passed the winter of 1852-53 at Melville Island. M'Clintock travelled with a sledge party for 105 days, covering 1328 miles, Meham and Vesey Hamilton travelling for 94 and 97 days respectively. They completed the exploration of the north and west of Melville Island and of the coast-line of Prince Patrick Island.

#### May 5, 1255 — An Early Journey to Mongolia

William of Rubruck, or Rubruquis, reached Cilicia after his journey to the court of the Grand Khan. He was sent by Louis IX. of France as an envoy and left Acre in 1252. He went by sea to Constantinople, whence he sailed in May 1253 to the Crimea. He travelled by land to the Talas valley, penetrated to Lake Balkhash, passed the Ala Kul, entered Mongolia, and arrived at the court of the Khan on Dec. 25, later accompanying the court to the Karakoram. His narrative supplemented that of John de Plano Carpini, 1245-47. He gives interesting descriptions of the salt trade via the Don, and notes that the Caspian Sea is an inland sea and not a bay of the ocean, as was then believed.

#### May 6, 1788 — The Marshall and Gilbert Islands

Capt. Marshall left Port Jackson and was later joined by Capt. Gilbert, the two ships keeping together for most of the voyage. After passing Norfolk Island and sighting Matthew's Island in  $22^{\circ} 22' S$ ,  $170^{\circ} 41' E$ , the two captains navigated the little-known part of the Pacific in which they discovered the groups of islands which now bear their names.

### Societies and Academies

#### LONDON

Royal Society, April 21 — H. W. McKenny Hughes. Induced melanism in Lepidoptera. Females of the Geometrid moth *Selenia bilunaria*, Esper, were collected in three different areas in southern and eastern England, as far as possible away from industrial areas. Two generations were fed upon pure untreated hawthorn, after which four subsequent generations were fed upon hawthorn treated with lead and manganese salts respectively. Brother and sister matings were adopted throughout the experiment. Adequate control broods were kept, and in all 3265 moths were reared. No melanic individuals appeared at any time, either in the control or treated broods — S. Adler and O. Theodor. Investigations on Mediterranean kala azar (6). Canine visceral leishmaniasis. Eleven out of 100 dogs examined in Malta between June and November were found to be naturally infected with kala azar. Seborrhea and partial depilation are the most frequent signs of canine kala azar and were found in nine out of eleven cases. The skin condition is due to infiltration of macrophages round hair follicles. Infected macrophages are found throughout all parts of the skin, both in the areas of infiltration round the hair follicles and in normal dermis. Sandflies, *P. perniciosus*, were infected with *Leishmania* by feeding on the unbroken skin of three dogs. The infection rates were 62.5 per cent, 65.4 per cent, and 32 per cent respectively — R. H. Stoughton. The morphology and cytology of *Bacterium malaccarum*, E. F. S. (2). Reproduction and cell-fusion. New morphological forms have been observed. The production of coccoid bodies, their liberation, and subsequent germination to form apparently normal rods, is described. The formation of densely-staining spherical bodies, apparently arising

from the point of fusion of two cells, is described. These bodies are apparently liberated by the degeneration of the parent cell.

#### PARIS

Academy of Sciences, March 14 — Ernest Esclançon. Talking clocks designed for the telephonic distribution of the time. Two types of apparatus are described, both depending on the use of a photoelectric cell with amplifiers. It is proposed to instal these at the Paris Observatory for telephonic distribution of time through the Post Office — A. Cotton and H. Mouton. The optical properties of a thin layer of nitrobenzene submitted to electrostatic stress. A thin layer of nitrobenzene, submitted to alternating current (1000 to 2500 volts), shows double refraction. It differs from the Kerr effect in that the double refraction develops slowly (2-3 minutes) and takes a similar time to disappear after suppression of the field — L. Cayeux. The interpretation of the deposits of calcium phosphate dredged on the Agulhas Bank, to the south of the Cape of Good Hope. The Agulhas Bank phosphate deposit is formed of materials foreign to the green sand on which it rests. The nodules of phosphate are derived from deposits formed at greater depths than those where it is now found. The current formation of phosphatic deposits on the sea floor cannot be proved — V. Grignard and J. Colonge. A new general method for the condensation of ketones — Henri Logatu and Louis Maume. Can the leaf accept an excess of mineral food without benefiting the development of the plant? The leaf of the potato can show a marked excess of potash without benefit to the plant — Louis Lapique. The verification of decease by a medico-scientific test clearly proving death with certainty — Jean Cantacuzène was elected *correspondant* for the Section of Medicine and Surgery, and Emile Guyénot *correspondant* for the Section of Anatomy and Zoology — Jean Mascart. Remarks on logarithms — Georges Durand. The application of the conception of contingent to the research on the characters of planicity for a simple arc — S. Mazur and S. Ulam. The isometric transformations of vectorial spaces, *normés* — A. Marchaud. The limiting demisecant and semi-tangents — Karol Borsuk. The conception of local contractibility of ensembles — Edouard Callandreau. The close connexion between Coulomb's and Boussinesq's theories of the thrust of soil — Paul Santo Rini. A high frequency method for the study of vibrations both at the surface and in the interior of a solid, especially the framework of a bridge — Nicolas Kryloff and Nicolas Bogoluboff. Some examples of non-linear vibrations — P. Lambert and J. Lecomte. The infra-red absorption spectra of hydrocarbons with nucleus. Results of the application of the recording spectrometer described in a previous paper to the infra-red absorption of derivatives of cyclohexane, cyclohexene, and naphthalene — R. Freymann and S. Takvorian. The absorption spectra of the rare earths in the infra-red. The spectra were studied in the region  $0.82\mu$ – $1.16\mu$ . Some new absorption bands have been detected, and these are of interest from the point of view of analysis — Maurice Robert. A new method of study and of regulation of a television transmitter — S. Rosenblum and M. Valadares. The fine structure of the  $\alpha$ -rays of thorium-C. Utilising the large electromagnet of the Academy of Sciences, a new faint line ( $\alpha_5$ ) has been detected. The line  $\alpha_4$ , noted as doubtful in an earlier note, is confirmed — P. Reiss. The intervention of equilibria of oxidation-reduction in the permeability of a membrane — W. Broniewski and S. Koslacz. The silver-copper alloys — A. Perret. The action of primary amines on dicyandiamidine sulphate. Under

certain conditions detailed, a primary amine  $R\ NH_2$  reacts with the acid sulphate of dicyandiamidine—giving guanidine sulphate and the symmetrical urea  $CO(NH\ R)_2$ —P Weill and Mlle Madeleine Darmon. The isomerisation of phenylglycide. The affinity capacity of the primary alcohol group—J Bougault and Mlle Pinguet. The combinations of allantoxanic acid and of allantoxidine with the alkaline bisulphites. Crystalline compounds are formed, slightly soluble in water and hence useful from the analytical point of view—R Marcel Godchot and Max Mousseron. The resolution of *o*-aminocyclohexanol into its optical antipodes—Mlle D Biquard. The preparation of the cyanhydrins of the formula  $C_6H_5(CH_2)_n\ CH(OH)\ CN$ ,  $C_6H_5(CH_2)_n\ CH(CH_3)\ CH(OH)\ CN$  and the corresponding  $\alpha$ -acid-alcohols—Ch Courtot and P Chiffert. The aryl thioniums with strictly hydrocarbon radicals—M Battegay and H Silbermann. The aryl ethers of pseudo-urea—J P Arend. The constitution of oolitic minerals and its relation with the facies of the deposits—Andre Demay and Henri Longchambon. The antistephanian tectonic of the Cevennes at the height of Largentiere—Raymond Furon. The extension of the marine Devonian in western Africa—Antonin Lanquine. The dislocations of the secondary strata of the valley of Caramy, below its confluent with the Issole (Var)—L Dubertret, A Keller, and H Vautrin. Contribution to the study of the Syrian desert region—Henri Erhart. The types of soils in the loess district in Alsace—L Cagniard. The reflection of a spherical and isotropic seismic wave at the surface of the soil—L Eble and G Gibault. The values of the magnetic elements at the station of Val-Joyeux (Seine-et-Oise) on Jan 1, 1932—R Hickel. The two layers of tertiary plants in the Bas-Rhin—J Szymanek. Supplementary caryological observations on *Gossypium*—Paul Wintrebert. The preservation in paraffin sections of the vital marks in Bismarck brown and Nile blue, made on the living eggs of Amphibians—A Policard and A Morel. The comparative utilisation of a spark or of an arc in the spectrography of sections (histospectrography)—Maurice Lecamp. Grafts of fragments of the posterior limbs in *Alytes obstetricans*—A Girard, G Sandulesco, A Fridenson, C Gaudefroy, and Ir J J Rutgers. The crystallised sexual hormones extracted from the urine of pregnant mares. Detailed crystallographic study of folliculine and equiline. The composition of the latter is probably  $C_{18}H_{20}O_2$  its physical, chemical, and physiological characters are described. A third crystalline hormone isomeric with equiline (hippuline) has been isolated—Mmes Eudoxie Bachrach and Jeanne Roche. The prolonged action of potassium chloride produces a displacement of the thermal optimum of yeasts—Ph Lasseur, M Pierret, A Dupaux, and C Maguitot. Remarks on the bactericidal power of metallic silver—Michel Faguet. Contribution to the study of microbial multiplication (*Bacterium coli*). The opacity of a broth culture is taken as measuring the number of micro-organisms. The variations in the opacity have been measured and recorded by means of a photoelectric cell. A reproduction of a 12-hour record is given—C. Jonesco-Mihaiesti, D Noica, and B Wisner. The experimental transmission to the ape of a disseminated human encephalomyelitis—G Mouriquand, A Leulier, and Mlle Weill. Age and substances preventing the assimilation of lime.

## LENINGRAD

Academy of Sciences—*Comptes rendus*, No 11, 1931—V. Vernadsky. The field of stability of the liquid carbonic acid in the biosphere. Carbonic acid in liquid form exists in microscopic pores of many

minerals and must play an important part, but the problem has never been studied. Still more important is the fact that the low average temperature of water in oceans, coupled with great pressure in oceanic depths, make the existence in deep waters of liquid carbonic acid a certainty, and this cannot be without an effect on the life of organisms. It is possible, for example, that the absence of planktonic organisms at relatively small depths, where there is still light, is due to peculiar conditions for respiration owing to a certain part of the carbonic acid being in liquid state (see also NATURE, April 23, p 607)—V Chlopin. Geochemistry of noble gases—E Krinov. A bolide meteor of Nov 23, 1930, in the Nizny-Novgorod region. Observations by eye-witnesses are quoted and a sketch-map of its track is presented—A Reichardt. On a new representative of the genus *Philotis*, Rehd. Description of *Philotis atavus*, sp n, from Buchara.

## SYDNEY

Linnean Society of New South Wales, Nov 25—W. W. Froggatt. A classification of the gall-making coccids of the genus *Apiomorpha*. The male and female galls are described and the range of each species, together with the name of the host eucalypt, is given. The species of the genus are classified into groups based on the form and disposition of the hairs and spines on the dorsal surface and the structure of the anal appendages—Ida A Brown. The stratigraphical and structural geology of the Devonian rocks of the south coast of New South Wales. The formations found in the south coast district are correlated with a number of other occurrences of Devonian rocks in south-eastern Australia, and the palaeogeography of the Devonian era is considered—H M R Rupp. Notes on New South Wales orchids. A description is given of a teratological specimen of *Caladenia testacea* from the South Maitland coalfields, and a distinctive form of *Dendrobium teretifolium* var *farfara* is recorded—Gladys Carey. Note on the leaf-buds of *Angophora*. More detailed examination of the leaf bud of species of *Angophora*, previously described by the author as "an ill-defined axillary swelling", shows that this swelling is in reality a deep-seated bud of peculiar type in which the primordia are well differentiated—Lilian R Fraser. An investigation of *Lobelia gibbosa* and *Lobelia dentata*. Mycorrhiza, latex system, and general biology. The root is infected from the first by the fungus, which remains in an intercellular position in the cortex. The fungus infects the younger parts of the root and all lateral roots by growing down from the older region, and goes through a series of changes, being finally almost crushed out by the cortical cells of the root. Reinfestation of roots takes place at intervals from the soil, rhizomorph-like strands of the fungus coming into contact with the root and penetrating into the cortex. The latex system of the two species is briefly described.

## Forthcoming Events

FRIDAY, APRIL 29

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Department, Imperial College of Science and Technology), at 2.30—Dr S G Paine. The Relationship of Micro-organisms to the Decay of Stone—Dr E S Moore. Virus Disease Problems in Tobacco Cultivation in South Africa.

ROYAL ASTRONOMICAL SOCIETY, at 4.30—Geophysical Discussion. The Maintenance of the Earth's Electric Field. To be opened by Dr F J W Whipple, and continued by Dr G C Simpson and others.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7—Dr C V Drysdale Future Progress in Electrical Measuring Instruments (Lecture)  
 ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Prof H Hartridge The Rival Theories of Hearing

#### MONDAY, MAY 2

ROYAL INSTITUTION OF GREAT BRITAIN, at 5—Annual Meeting  
 UNIVERSITY COLLEGE, LONDON, at 5 15—Prof O Grosser Human and Comparative Placentation, including the Early Stages of Human Development (1) (Succeeding Lectures on May 5 and 6)  
 SCHOOL OF ORIENTAL STUDIES, at 5 30—Prof G Morgensterne The Káirs of the Hindu Kush (1) (Succeeding Lectures on May 4 and 6)  
 ROYAL SOCIETY OF ARTS, at 8—Prof J C Drummond Recent Researches on the Nature and Function of Vitamins (Cantor Lectures) (3)  
 SOCIETY OF CHEMICAL INDUSTRY (London Section) (Annual Meeting) (at Chemical Society), at 8, followed by a General Discussion on Smoke Abatement in Industry

#### TUESDAY, MAY 3

ROYAL ANTHROPOLOGICAL INSTITUTE (African Research Committee), at 4 30—Methods of Study of Culture Distribution in Africa  
 ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5—Dr Harriette Chick The Relation of Light to Nutrition (Oliver-Sharpey Lectures) (1)  
 ROYAL SOCIETY OF MEDICINE (Orthopaedics Section), at 5 30—Annual General Meeting  
 UNIVERSITY COLLEGE, LONDON, at 5 30—Dr W A Shewhart The Role of Statistical Method in Industrial Standardisation (1) (Succeeding Lectures on May 5 and 6)  
 GOLDSMITHS' COLLEGE (New Cross), at 5 45—Exhibition in connexion with the Teaching of Geography—At 5 45—Sir Halford Mackinder Inaugural Address

#### WEDNESDAY, MAY 4

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5 30—Aldous Huxley Huxley as a Literary Man (Huxley Memorial Lecture)  
 NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (at London School of Economics), at 5 30—Dr C S Myers Psychological and Social Factors in Business Rationalisation (1) The Significance of Rationalisation  
 GOLDSMITHS' COLLEGE (New Cross), at 5 45—L Brooks The Teaching of Geography—The Modern Approach  
 EUGENICS SOCIETY (at Royal Society)—Annual General Meeting

#### THURSDAY, MAY 5

IRON AND STEEL INSTITUTE (at Institution of Civil Engineers), at 10 A M—Annual Meeting  
 ROYAL SOCIETY, at 4—Election of Fellows  
 ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5—Dr Harriette Chick The Relation of Light to Nutrition (Oliver-Sharpey Lectures) (2)  
 LONDON SCHOOL OF ECONOMICS, at 5—Dr R R Marett Covenant in Primitive Economics, Law, and Religion (1) (Succeeding Lecture on May 12)  
 GOLDSMITHS' COLLEGE (New Cross), at 5 45—Prof. E G R Taylor First Ventures on the Atlantic—A Study in the Relations of Human and Physical Geography  
 INSTITUTION OF ELECTRICAL ENGINEERS (Varley Centenary Meeting), at 6—Lt-Col A G Lee The Lives and Work of Cromwell Fleetwood Varley (April 6, 1828) and Samuel Alfred Varley (March 22, 1832)—Annual General Meeting, at 6 45  
 SIR JOHN CASS TECHNICAL INSTITUTE (31 Jewry Street, E C), at 7—Prof C O Bannister Ancient and Modern Metallurgy (Armourers and Biasiers' Company Lectures) (1) (Succeeding Lectures on May 12 and 19)

#### FRIDAY, MAY 6

IRON AND STEEL INSTITUTE (at Institution of Civil Engineers), at 10 A M—Annual Meeting  
 ROYAL SOCIETY OF MEDICINE (Otolaryngology Section) (Annual

General Meeting), at 10 30 A M—Discussion on Labyrinthitis

CAMBRIDGE UNIVERSITY (in Senate House), at noon—Prof A Einstein Die Theorie der Elektrizität im Rahmen der allgemeinen Relativitätstheorie (Rouse Ball Lecture)

INSTITUTION OF MECHANICAL ENGINEERS (London Spring Meeting), at 2 30—A Binns Recent Developments in the Mechanical Equipment of the Port of London Authority

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4 30—Miss B M le P Power Indian Labour Conditions

SOCIETY OF CHEMICAL INDUSTRY AND INSTITUTE OF CHEMISTRY (Joint Scottish Meeting) (at University, St Andrews), at 5—Prof J Read Alchemical Literature and Iconography (Lecture)

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5—Annual General Meeting

PHYSICAL SOCIETY (in Physiological Laboratory, University College), at 5—Prof A V Hill The Measurement and Analysis of the Heat Production of Nerve (Lecture)

UNIVERSITY COLLEGE, at 5 30—Sir Bernard Pares Russia and the West (Lecture)

GOLDSMITHS' COLLEGE (New Cross), at 5 45—Prof J F Unstead Recent Developments of the Regional Method—as applied to Teaching

ROYAL INSTITUTION OF GREAT BRITAIN, at 8 30—Conversazione

ROYAL SOCIETY OF MEDICINE (Anaesthetics Section), at 8 30—Annual General Meeting

CAMBRIDGE UNIVERSITY (in Anatomy Lecture Room, New Museum)—Prof J J R Macleod Lincro Lecture

#### SATURDAY, MAY 7

GOLDSMITHS' COLLEGE (New Cross), at 3 30—Prof H J Fleure Social and National Ideals in their Geographical Settings—A Study of Some European Problems

### Official Publications Received

#### BRITISH

The West of Scotland Agricultural College Research Bulletin No 2 A Nematode Disease of Potatoes caused by *Heterodera schachtii* (Schmidt) By Dr D G O'Brien and E G Prentice Pp 63+28 plates (Glasgow)  
 Proceedings of the Royal Irish Academy Vol 40, Section B, No 14 Observations on the Reproduction of *Nyctophanes couchii* (Bell) and *Megacyrtophanes norvegica* (Sars) off the South Coast of Ireland By Winifred B Frost Pp 193-232 1s 6d Vol 40, Section A No 6 A Characteristic Property of Systems of Paths By Charles H Rowe Pp 99-106 6d (Dublin) Hodges, Figgis and Co., London Williams and Norgate, Ltd.)  
 Reports of the Council and Auditors of the Zoological Society of London for the Year 1931, prepared for the Annual General Meeting to be held on Friday, April 29th, 1932, at 4 p.m. Pp 99 (London)  
 Dominion of Canada Fourteenth Annual Report of the National Research Council containing the Report of the President and Financial Statement, 1930-1931 Pp 210 (Ottawa)  
 Tanganyika Territory Geological Survey Department Bulletin No 2 Report on the Geology of the Ruhuhu Coalfields, Njombe—Songea Districts, being a Preliminary Geological Survey of the Karroo Rocks, East of Lake Nyasa, by G M Stockley, and Technical Report on the Coal Samples, by F Oates Pp vi+68+7 plates (Dar es Salaam Government Printer) 5s

#### FOREIGN

Carnegie Institution of Washington Annual Report of the Director of the Department of Terrestrial Magnetism (Reprinted from Year Book No 30, for the Year 1930-31) Pp ii+281 37s (Washington, D C Carnegie Institution)  
 Bulletin of the Earthquake Research Institute Tokyo Imperial University Vol 10, Part 1, March Pp 272+38 plates (Tokyo Iwanami Shoten) 4 45 yen  
 Académie Tchèque des Sciences (Česká Akademie Věd a Umění) Bulletin International Résumés des travaux présentés, Classe des sciences mathématiques, naturelles et de la médecine 29<sup>e</sup> année (1928) Pp iv+556 30<sup>e</sup> année (1929) Pp v+475 (Prague)  
 Proceedings of the Imperial Academy Vol 8, No 2, February Pp iii+27 57 (Tokyo)  
 Methods and Problems of Medical Education (Twentieth Series) Pp iv+250 (New York City The Rockefeller Foundation)

#### CATALOGUES

General Catalogue of Books and Prints, 1932 (No 547) Pp 96 (London Francis Edwards, Ltd)  
 Important and Rare Books on Gardening (including Herbals), Agriculture and Husbandry (1481-1800) (New Series, No 27) Pp 52 (London, Wheldon and Wesley, Ltd)  
 A Catalogue of Book Bargains (No 535) Pp 16 (London William Glazier, Ltd)



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## Scientific Worthies

XLVI—THE RIGHT HON LORD RUTHERFORD OF NELSON, O M, F R S

IT is often a matter of surprise to note the profound differences between the methods the human mind adopts towards the problems it is seeking to solve, and any narrow classification would necessarily be inexact because of the variety of possible temperaments. Among the scientific investigators who have devoted their lives to the study of physics, two main tendencies can, however, be noted. On one hand, there are those who are dominated by the abstract aspect. They are interested not so much in the facts as in the theories to which these facts lead. There is no lack of illustrious men to whom the intellectual aspect has appeared the more important, and quite recently striking successes have resulted from just such methods of investigation. Other scientific men, while not denying that the object of science is to correlate and to predict phenomena, and without confining themselves merely to the compilation of facts, yet feel that we are so far from being able to form a logical and clear idea of reality that we are scarcely beyond the point of realising the danger of too abstract generalisations. Such generalisations run the risk of describing more the mind of the man who puts them forward than Nature itself—which is the object of research and of experimental physics. As has often been remarked, facts serve to produce theories, leading in their turn to the discovery of new facts, which may in their turn destroy the theories by which they were discovered.

The scientific career of Lord Rutherford is a splendid example of this second method of physical investigation, and it will be sufficient to show that this point of view is not in any way inferior either in importance or in fertility to the other.

Lord Rutherford's earliest work was in a sphere quite apart from that to which he has since devoted his life, but it showed clearly enough his remarkable qualities as a physicist. He investigated the change in the magnetisation of a steel wire due to the passage of oscillatory currents, and he was able to show that Hertzian waves could, by producing oscillatory currents, cause a sudden diminution in the magnetisation of such a wire. This discovery was utilised later by other workers and developed to form a detector for wireless telegraphy.

The three years, 1895–98, which Lord Rutherford passed at Cambridge working under Sir J. J. Thomson determined the orientation of his future

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interests by permitting him to study the newly discovered properties of ionised gases and the causes of this ionisation. He went to McGill University in Montreal imbued with the ideas and inspiration which had enabled Sir J. J. Thomson to make the Cavendish Laboratory a birthplace of famous physicists. It was not long before the young professor found in radioactivity the subject for which his peculiar genius was most suited. It was then 1898, two years after the discovery by Becquerel of the radioactivity of uranium, Pierre Curie and Mme. Curie had just added greatly to the range of the new phenomenon by discovering polonium and radium, and the list of the radioactive bodies already included thorium and the two alkali metals.

While, however, the far-reaching importance of these new discoveries was obvious to everyone, the interpretation of the facts in this new domain presented fundamental problems which remained unanswered. A most important research from this point of view was published in 1900 by Rutherford, from Montreal, when he was able to show that the thorium bodies gave out a type of radioactive emanation. He maintained the view that this was in effect a material gas constituting a new chemical species which should find a place in the family of inactive gases to which helium and argon belonged, and this was ultimately, in collaboration with Soddy, shown to be true. This bold hypothesis received a most striking confirmation when the more marked and more permanent phenomena shown by radium emanation were discovered in their turn.

Following up his researches on thorium, Rutherford was able to detect the presence of an induced radioactivity which he attributed to an active deposit, invisible and yet material, carried in the form of electric particles which could be concentrated on an electrode by means of an electrostatic field. This active deposit was an attribute of the emanation and was thus an example of the affinity which exists between the radioactive bodies. Later, while studying the radium emanation discovered by Dorn, Rutherford found many properties which emphasised its material properties, as, for example, that it could be condensed in suitably cooled tubes. He was also able to obtain a complete spectrum of this new chemical element, which Ramsay and Soddy had shown beyond doubt was a gas. It is very remarkable that Rutherford and Soddy suggested in 1902 that helium might be one of the products of disintegration of the radioactive bodies.

The year 1903 was one of the most decisive for the new science which was then growing up, for it saw in effect the discovery of the production of helium from radium emanation, the fundamental discovery by Curie and Laborde that preparations of radium gave out a continual supply of heat, and it also saw the birth of the theory of radioactive transformations put forward by Rutherford and Soddy to explain the facts shown by the thorium family. At first sight many of the phenomena shown by the radioactive bodies were very strange; the activity did not always seem to depend upon the bodies which constituted the source, it could be carried to a certain distance and could there produce the phenomenon called induced activity, all of which was very obscure. Neighbouring surfaces, without apparently suffering any modification, acquired a power of emitting radiations for which the rate of decrease with time appeared to be connected in a mysterious way with the growth of activity of the primary substance. To-day, when we have a theory of the atom, admittedly rough, but which yet explains in an admirable way a great number of diverse facts, the interpretation of these phenomena, so inexplicable in the early days, now seems simple enough. But if one looks back to the year 1900, when the ideas of the nuclear atom, and of Bohr orbits, were as yet unformulated, it will readily be appreciated what imagination and what sureness of intuition were necessary in order to disentangle so rapidly such a complication of strange and new facts.

Rutherford and Soddy put forward in 1903 a complete theory of these phenomena which permitted the prediction, both qualitatively and quantitatively, of the whole complicated consequence of events. This theory was based on a conception of the utmost simplicity which has since served, without any modification, to classify all the facts discovered in this new domain.

The fundamental idea of this theory is that among the great number of atoms of a body which possess the property of radioactivity, there is a definite probability that in a given time a certain number of these atoms will have changed into a new type by the ejection of a material particle owing to a type of instability. In other words, the number of atoms which change in unit time is always proportional to the total quantity of matter which is then present.

A detailed calculation then showed that such a substance will disappear according to an exponential law, if the new atoms are also unstable and are transformed much more rapidly than the first kind.



(which is the case for uranium, radium, and thorium), there will result a type of equilibrium between the successive descendants of the same radioactive family, so that their relative proportions are perfectly defined in the minerals and in the preparations which contain them. The radiations which are emitted are a direct result of the transformations of the atoms and therefore provide an exact measure of its rate of disintegration.

Schweidler and later Kohlrausch showed that Rutherford's theory, which was at first presented as a kind of analogy with irreversible monomolecular reactions, could be viewed entirely from the point of view of chance and was therefore subject to the laws of the calculus of probability. This was perhaps one of the first examples of the intervention of statistical laws in fundamental atomic phenomena, an idea of which the more recent discoveries of physics have shown both the generality and the profound philosophic importance. In the light of present knowledge, one may well ask to-day whether such a law was not imposed *a priori* to the exclusion of all others.

The laws of radioactive disintegration thus stated formed a framework for the classification of all the new substances produced by the successive transformations of each family. Thus a new chapter in physics and in chemistry was begun, that of matter in a state of evolution, which has led in time to all that we know to-day about radioactivity.

But besides this, the study of the radiations, the investigation of their nature, of their properties, and of their effects, form a peculiarly interesting branch of this new science, and it is only necessary to compare the early works of Mme. Curie and of Rutherford with the latest volumes published by Kohlrausch and by Rutherford to understand the double aspect of the facts grouped under the name of radioactivity.

After 1905, Lord Rutherford directed his efforts mainly to the study of the radiations, and the success which he achieved in this field was not less than that which had greeted his earlier efforts. There are three kinds of rays,  $\alpha$ ,  $\beta$ , and  $\gamma$ , and Lord Rutherford's earliest work was concerned with distinguishing between them. Afterwards, commencing with the  $\alpha$ -particles, he has contributed more than anyone else to establishing the fact that they consist of helium atoms carrying a double positive charge and projected with a velocity corresponding to an energy of several millions of volts. It has been possible not only to study the properties of a beam of  $\alpha$ -rays, but also to detect the effect of single particles and to count them by

direct methods, which in course of time have been developed to a high degree of perfection. The detection of single particles has now rendered possible the detailed verification of the predictions of the law of probability about the distribution of the particles both in space and in time.

The expulsion of helium nuclei and of  $\beta$ -particles, that is, high speed electrons, from the radioactive nucleus, threw a new light on the whole problem of the constitution of atoms. This question had previously seemed so remote that no one had dared thus to think of it before the first ten years of the twentieth century. In fact, it remained so obscure that, at the first Solvay Conference, when it was asked what picture one could form of the emission of spectral rays, the eminent specialists there present were caused merely to reveal their own ignorance on the subject. No one was better placed than Lord Rutherford to make a decisive attack on this problem, by bringing to it a definite atomic model founded on experimental facts.

Various experiments carried out under his direction on the scattering of rapid particles in their passage through matter led to the formulation of an approximate law describing the deviations, and this Lord Rutherford saw could only arise if there was some kind of condensed nucleus forming the central part of the atom. This theory, put forward in 1911, was greatly expanded and developed in 1914, after the splendid theoretical work of Bohr and the notable experiments of Moseley, which were both carried out in Lord Rutherford's laboratory. From this resulted the atomic model universally accepted to-day and known under the name of the Rutherford-Bohr atom. In this model, as is so well known, the atom is supposed to be formed by a central nucleus carrying a positive charge and surrounded by a cloud of satellite electrons, the number of which is equal to the number of the net positive charges on the nucleus. This whole number, called the atomic number, plays an essential rôle in the theory of spectra, in the classification of elements, and in all problems connected with atomic physics. It shows the position of an element in the natural order of the elements, characterises the chemical type, and, in conjunction with the number of protons in the nucleus, constitutes even to-day the data of which we are most sure in relation to the ultimate particles of matter.

The  $\beta$ -rays and the  $\gamma$ -rays also occupied the attention of Lord Rutherford and his school, and in 1914 he was able to obtain for the first time a spectrum of the  $\gamma$ -rays by diffraction from a crystal of rock

salt The experimental method was extremely ingenious and was specially adapted to work with the necessarily small angles of reflection In this way he was able to show that the  $\gamma$ -rays were analogous to the X-rays, but of shorter wave-length

The electrons of different speeds which constitute the  $\beta$ -radiation can be separated out by a magnetic field, and a detailed analysis of this emission, and also the study of the high speed secondary electrons which are produced, formed an important chapter in the researches undertaken at about this time The  $\gamma$ -rays emitted by radioactive bodies form a line spectrum, and while the greater portion of the  $\beta$ -rays form a type of continuous spectrum the origin of which is yet obscure, there is also a series of groups of electrons of definite speed which, when analysed by a magnetic field, form a type of corpuscular spectrum The question as to whether there should be a connexion between these two spectra by means of the photo-electric effect was considered by Lord Rutherford, and later, in the hands of his co-workers, experiments on this subject threw great light on the complexity of the emission of the  $\beta$ -rays In this way it was possible to study the spectrum of the  $\gamma$ -rays, although their wave-lengths were so short as to render the normal method of crystalline diffraction inapplicable

Finally, there is a third phase of Lord Rutherford's work, marked by discoveries no less important than those preceding, and concerned with the artificial disintegration of the lighter elements by bombardment with the  $\alpha$ -particles emitted by radioactive bodies According to present ideas, which are in great part due to the researches which have just been referred to, the chemical properties of an element depend entirely on the value of the nuclear charge Some of the electrons which surround the nucleus can be removed, or even the nucleus may be stripped bare, when the atom would in the first case be partly, and in the latter case completely, ionised, yet still, from the point of view of the chemical nature of the element, it would be the same as at the commencement of the process, and the atom would regain all its former properties as soon as it had recaptured its full number of electrons In order to effect a change in the atomic species, it is essential to change the positive nucleus It may be said, indeed, that the nucleus determines the structure of that portion of space which constitutes the atom This central fort is guarded by strong defences There is an intense electric field which opposes the progress of a projectile which approaches it, and will in fact

prevent its arrival unless it be endowed with very great energy It occurred to Lord Rutherford that the  $\alpha$ -particles did in fact constitute precisely the most powerful type of projectile at our disposal for attacking the nucleus, and he proceeded to use this weapon

It was therefore in 1919 that for the first time an actual case of chemical transmutation of an element was proved scientifically It was found that the hydrogen nuclei, which are to-day called protons, could be detached from the nuclei of nitrogen and other bodies by bombardment with  $\alpha$ -particles In the case of aluminium, the explosion sets free a certain quantity of intra-atomic energy, which gives the proton greater energy than that of the incident projectile

This was the beginning of a new branch of physics and chemistry, that of artificial radio-activity At first progress was somewhat slow, due to inherent difficulties in the early experimental methods, but now the science is making great strides There is little doubt that it will quickly lead to important results and throw light on the intimate details of this new world of nuclei which the work of Lord Rutherford has opened up for the physicists of the future

As professor of physics at Manchester—where he obtained in a few years so many striking results that it has been possible to form a museum of historic apparatus—and then at Cambridge, a successor to the great line of illustrious physicists of which the last, Sir J J Thomson, had just retired after influencing the whole subject of physics in a way which becomes more apparent every day, Lord Rutherford has continuously affected all those who surround him by his personal influence He has maintained and even increased the great traditions of the Cavendish Laboratory, from which have come so many admirable researches and so many notable men of science The list of the physicists who have worked under his direction is a long sequence of names of which the greater number have attained fame, and in no small measure is the brilliance and certainty of the results due to the continual co-ordination of a series of researches directed towards one end The number of distinguished physicists who have co-operated in this advance is so large that it would be impossible to mention all and invidious to choose a few, but reference to any work on radio-activity will show how many have worked under Lord Rutherford and collaborated in his researches.

Taking Lord Rutherford's work as a whole, one finds that underlying it there is always a concrete

picture of the problems based on direct experiments, and then, avoiding all mathematical complications, these experimental facts are connected up by means of a theory which gives a direct visual picture of the phenomena. Recent theoretical views suggest that such a mechanistic view of Nature cannot be pushed beyond a certain point, and that the fundamental laws can only be expressed in abstract terms, defying all attempt at an intelligible description. The philosophy of science has always swung between these two points of view. The work of the great physicist to whom these lines are dedicated shows, however, to what brilliant discoveries the method followed by Lord Rutherford can lead.

M DE BROGLIE

### New Guinea Sorcerers

*Sorcerers of Dobu the Social Anthropology of the Dobu Islanders of the Western Pacific* By Dr R F Fortune Pp xxviii+318+8 plates (London George Routledge and Sons, Ltd, 1932) 15s net

DR FORTUNE has given us a remarkably interesting and valuable account of the natives of the islands of Tewara, Dobu, and of the village of Basema, all in the D'Entrecasteaux group, which lies off the south-east end of New Guinea. Previously we had only the general observations of government officials in the Annual Reports of Papua, the useful little book "The Northern D'Entrecasteaux", by Jenness and Ballantyne (Oxford, 1920), and a few notes by various travellers. The great merit of this book is that it describes the functioning of society and of social activities—it is thus a dynamic survey and not merely an account of social structure, as has usually been the case in previous ethnological studies—and, indeed, it is a good illustration of the modern method of field-work.

The social unit of the Dobuans is the *susu*, or matrilineal group, of which a variable number constitute a village. Every husband must come from another village, and he has but a precarious position in his wife's village, as there is a strong solidarity between the wife, her brothers, and all other members of that *susu*, and, in addition, divorces are frequent. Every alternate year the family lives in the wife's and in the husband's village. When a man dies, he is buried in the domicile of his own *susu*, and thereafter his children may never enter that village. The marital group, or simple family, is necessarily weak as compared with the *susu*, and each village contains a hetero-

geneous collection of men from different villages, who distrust one another. A man cannot alienate from his sister's children, in favour of his own, his village land, his personal name, his skull, his status, or his fruit trees, but he can, and often does, teach his son his magical formulæ, and he is obliged to teach these to his sister's son. Teaching both parties is really a subversive action, as magic gives power, status, and a small income, and when put in the hands of individuals who are very apt to be antagonistic they may use it one against the other. A father will never give his magic to more than one son, the others are left magicless, with the result that blood brothers are usually very jealous of one another. Practically all property descends in the *susu*, but a father may give some garden land that lies away from the village to his son, as well as to his sister's son, but no child can eat of any fruit or crop grown on land that was his or her father's, though such food can be exchanged for food from someone else's dead father's land.

All activities such as gardening, the lashing of canoes, the love between man and woman, and even disease, death, wind, and rain, are supernaturally created by the ritual of incantation with the help of the appropriate technological processes, gifts, and the like. Technology and mundane measures are not to be despised, but the incantation is the really important factor. Incantations are directed to supernatural beings, many of whom originally were human beings but are now immortal, their names are never pronounced except in inaudible undertone in actual ritual. It was they who originated the formulæ and gave them to the first ancestors of man, but nothing happens if the possessor of the formulæ does not use it. For example, in the ritual addressed to seed yams, the man is not muttering a form of words to yams merely, he is addressing a Personal Being, for yams are such in a metamorphosed form. The section on social organisation in gardening and the ritual of the garden are of particular interest.

Sorcery permeates the whole life of the Dobuans and is an integral part of their supernatural system; it "is practised by everyone, and believed in firmly by everyone. Like most supernatural systems it enlists its believers, not by tricks, deceits, and stratagems, but by a more dignified faith in the reality of Unseen Forces, and in the reality of the power of human speech to affect these Unseen Forces, that were 'born with the sun and the moon and the earth'." In an appendix, Dr Fortune criticises the action of the administration towards sorcery.

The system of periodical ceremonial exchanges of valuables between a circle of islands, known as *kula*, which was first described in a masterly manner by Malinowski, is here dealt with from a somewhat different angle. One group of a particular kind of valuables passes in one direction and another kind in the opposite direction, but the retention of them is purely temporary and they circulate indefinitely. Dr. Fortune makes the illuminating remark that the *kula* is like an annually repeated peacemaking ceremony, hence "the *kula* exchange of ornamental valuables, useless enough in itself, helps to maintain annual exchanges of other" and useful objects. The peoples of the islands are great traders, as has been shown by Seligman, but we are told that it is all done without direct barter. There is no haggling, it is a matter of giving and receiving presents. The great prestige of the *kula* undoubtedly makes strongly for peaceful relations between potentially hostile internationalists, and at the same time is a strong protection to ordinary trade in an area rent by the fear of the black art, suspicion, and hostility.

In his introduction, Prof. Malinowski makes some comparisons between the Dobuans and the Trobrianders, and the present writer agrees with him in his appreciation of the importance of Dr. Fortune's investigations and the manner in which he has presented them.

A. C. HADDON

### The Assembly of the Sages

*Turba Philosophorum ein Beitrag zur Geschichte der Alchemie* Von Julius Ruska (*Quellen und Studien zur Geschichte der Naturwissenschaften und der Medizin. Fortsetzung des Archivs für Geschichte der Mathematik, der Naturwissenschaften und der Technik. Herausgegeben vom Institut für Geschichte der Medizin und der Naturwissenschaften.* Redigiert von P. Diepgen und J. Ruska, Band 1.) Pp. x+368 (Berlin: Julius Springer, 1931.) 58 gold marks.

ANY man of science who wishes to see scientific method applied to solve literary and historical problems will savour intense intellectual delight in Prof. Ruska's book on the "Turba Philosophorum". A major enigma in itself, the *Turba* comprises a multitude of lesser riddles, and though the author with characteristic modesty describes his work as a mere preliminary study, he will be found to have left but comparatively little for future research to unravel. Like the Emerald Table of Hermes, upon which also Ruska has published a valuable investigation, the *Turba* enjoyed an authoritative reputation among

medieval alchemists, and was confidently quoted whenever it was desired to clinch an argument or conclusively to refute an opponent. An English version of this alchemical classic was made so long ago as 1896, by the learned historian of occultism, Mr. A. E. Waite, but a critical study of the problem as a whole remained unattempted until Prof. Ruska began his systematic work upon it in 1927.

Briefly put, the problem is as follows. In the form of *dicta* and of question and answer, the *Turba* purports to convey the alchemical tenets of an assembly of sages, some of whom have Greek names, while the names of others appear to have no parallel in any known tongue. Though the early manuscripts are in Latin, the queer phraseology and reprehensible syntax indicate that Latin was not the original language of the work, while numerous Arabic constructions and idioms, together with a large admixture of Greek alchemical ideas, seem to suggest that the *Turba* was written in Greek, translated into Arabic, and thence rendered into Latin. The principal part of the problem is thus to settle the origin of the treatise, the lesser, but by no means insignificant part, is to interpret the bizarre names and words that it contains, and to discover its affiliation to other early alchemical writings. Prof. Ruska's conclusion upon the chief point will be found irrefutable, his ingenuity in grappling with the others must excite our admiration as his faultless logic compels our assent.

The first fact that emerges from a close examination of the *Turba* is that the extraordinary proper names are to be regarded as Latin attempts to transcribe Arabic versions of Greek names. Proceeding from this basis, Prof. Ruska considers (a) the Arabic system of transcribing Greek words, and (b) the Latin system of transcribing Arabic words. Application of this method to the names in the *Turba* has led him to make a large number of unexpected but quite convincing identifications. Thus Iximidrus proves to be Anaximandros, Pandolfus is none other than Empedokles, Lucas is not Lucas but Leukippos, and Bonellus is the curious corruption of Apollonius as Horfolcos is of Herakleios. We may follow the steps of one of these remarkable equations. In medieval Arabic, Empedokles is rendered ANBADAQLIS. By the mere omission of an *alif* and a slight displacement of diacritical points this becomes BANDAFILUS, whence the Latin transcriptions Pandolfus and Pandophilus are seen to be not merely intelligible but almost inevitable.

The abundance of Greek personal names in the

Turba might seem to lend support to the thesis of a Greek origin of the work, but other facts definitely negative it. In the first place, it cannot be doubted that the Latin version is a direct translation from the Arabic, for in addition to the evidence just described, Prof. Ruska shows that many phrases and sentences are literal renderings of common Arabic formulæ. Most striking, perhaps, is the occurrence in one passage of a sentence from Sura 112 of the Koran. *Dico tamen, quod Deus unus est, nunquam genuit nec genitus est*. In a manuscript of the Turba at Erfurt, the copyist has added "secundum Sarracenos" to this heretical statement, while in other examples the offending words have been altered to *unumque genuit neque tamen genitus est*.

Yet the fact that the Latin Turba is a translation from the Arabic does not, in itself, exclude the possibility that the Arabic Turba may also have been a translation—a translation from the Greek. It would be easier to settle this question if Arabic manuscripts of the work were available, but although one at least was in existence in Cairo in 1537, none is known to be extant at the present day. Excerpts from the Turba are, however, to be found in certain other Muslim alchemical treatises, and it is not too much to hope that the whole book may be discovered sooner or later in some Cairene or Indian library. In spite of the lack of a complete Arabic text, Prof. Ruska is able to show—conclusively, as we think—that the Turba is not a translation from the Greek, but the original composition of some unknown Islamic chemist, probably of the ninth or tenth century. To summarise his arguments within the present limits is impracticable, but the attentive reader—especially if he be familiar with Muslim alchemy—will find that they carry conviction.

Prof. Ruska has completed his investigation into the sources of the Turba by the establishment of a critical Latin text, and by a careful and fully annotated translation into German. The fourth and concluding part of his book is a consideration of the literary problems involved, in which such points as the theological, cosmographical, and alchemical ideas of the Turba are discussed and elucidated. There are excellent indexes, and the typography is of a very high standard. Every scholar for whom the history of science holds interest will congratulate Prof. Ruska upon his brilliant achievement, and will congratulate himself upon the opportunity to add to his shelves a work as full of fascination as of sound learning.

E. J. HOLMYARD

## Rock Structures and their Interpretation

*Principles of Structural Geology* By Prof. C. M. Nevin. Pp. xi+303. (New York: John Wiley and Sons, Inc., London: Chapman and Hall, Ltd., 1931.) 17s. 6d. net.

THIS admirable book is one of the most competent and stimulating of the contributions to geological literature that have appeared in recent years. Structural geology is defined as the study of the framework of the earth's crust—and in its broader phases of the entire earth—and the causes responsible for its deformations.

After a preliminary chapter on the physical properties of rocks, the principles of the subject are developed, with special attention to the conception and application of the strain ellipsoid. Thus from the outset, ability to reason in three dimensions is made possible to the careful student. The author is, indeed, to be gratefully congratulated on the ingenious use he makes of this powerful instrument for structural analysis. Special care is taken to show that more than one interpretation may be possible of the evidence seen in the field, and "matters now in dispute among geologists are not avoided simply because they are unsettled." Successive chapters deal carefully and lucidly with flexures, faults, joints, cleavage, and structures in unconsolidated sediments. The illustrations and diagrams are excellent throughout. Each chapter affords the author an opportunity of discussing some of the larger problems of geology, with the result that the book is not only an unsurpassed guide to students but also a storehouse of valuable hints and clues which merit consideration by structural geologists in general.

The remaining chapters are devoted to rock structures and topography, and to more speculative matters regarding the earth as a whole, and such questions as isostasy, continental drift, and mountain building. Here, as throughout the book, Prof. Nevin follows so far as practicable the spirit of Voltaire: "Let us make an exact analysis of the matter and then we shall try to see, with much diffidence, if it fits any principle." The general working hypothesis is advanced, though in no dogmatic manner, that the earth is continually being deformed, that "separated periods of quiet and intense stress are true for localised areas such as the seats of future mountain ranges, and even for continental masses, but are mythical when applied to the earth as a whole." It is concluded that the contraction hypothesis rests on a very insecure foundation, that the possibility of

continental drift can no longer be safely ignored, and that the forces which cause mountain deformation and major vertical uplifts still remain complete mysteries

The book is so good that it presents an adequate excuse for asking for more. In a future edition, which should be called for at no distant date, chapters might well be added on igneous bodies and on rock-flowage. The index is not so full as it might be. Very few misprints or errors of fact have been noticed. On page 6 the term *amorphous* is used as if it did not include certain materials having strength. On page 229 *uranium* is twice printed where *radium* is intended, and determinations of radioactive elements in rocks are wrongly attributed to Kolhorster. Elsewhere the name of Jeffreys is given without the final letter. These slips, however, are negligible compared with the indisputable fact that Prof. Nevin has enriched geological literature with a treatise that is at once a textbook of outstanding importance and a discussion of earth problems that no geologist can afford to overlook.

### Short Reviews

*Vorlesungen über theoretische Physik an der Universität Leiden*. Von Prof. Dr. H. A. Lorentz. Band 5. *Die Maxwell'sche Theorie (1900-1902)*. Bearbeitet von Dr. K. Bremekamp. Übersetzt von Dr. H. Stuecklen. Pp. vii + 199. (Leipzig: Akademische Verlagsgesellschaft m. b. H., 1931.) 16/20 gold marks.

THE influence of the teacher, as exhibited in his lectures, may be powerful and lasting, but if his lectures remain unpublished, that influence is confined to the comparatively narrow circle of his direct hearers, and it becomes as difficult for one who has not sat at the feet of the teacher to appreciate his gifts as it is to judge at second hand the art of Garrick or of Kemble. Happily, the pious care of the pupils of Prof. Lorentz has rescued from oblivion much of value in his routine teaching, and we are fortunate not only in the worth of the subject matter thus permanently placed on record, but also in the picture it provides of another aspect of a great personality, a great advancer of knowledge, who is now seen as an inspiring teacher.

Whatever Lorentz touched, however commonplace or well worn the theme, he made his own. The lectures earlier printed showed us his clarity of thought, his systematic manner of building up his subject, and his rare capacity for wide and philosophic generalisation combined with attention to minute detail.

These qualities are again apparent in this compact volume, which opens with a section containing a brief but luminous discussion of the elements of vector algebra, of Stokes's and Green's theorems, of the

equations of Laplace and of Poisson. Maxwell's equations are then developed, and chapters follow which deal with electrostatics, steady and induced currents, the energy in the electromagnetic field, and the electromagnetic theory of light. It would be difficult to find a clearer development of the subject confined within the moderate compass of less than two hundred pages.

ALLAN FERGUSON

*Minds in Arrear: some Practical Aspects of Mental Deficiency*. By Dr. E. B. Sherlock. Pp. ix + 181. (London: Baillière, Tindall and Cox, 1932.) 5s.

DR. SHERLOCK was, until recently, medical superintendent of the Darenth Training Colony in Kent, so is particularly fitted to deal in an authoritative manner with any questions of mental defect. He wisely points out that his small book, "Minds in Arrear", is meant primarily for the general reader and not for the specialist. His attitude towards the generic term for mental defect is very broad-minded and in keeping with the most recent opinion. There is a growing tendency to get rid of, if possible, the term *amentia*, which means 'absence of mind' and is also used in Norway, Holland, and Italy to connote what is understood as confusional insanity. The word *oligophrenia*, invented by Bleuler, is a clumsy word, but will probably be finally adopted for international use.

Dr. Sherlock contrasts the normal mind with the abnormal mind, differentiating inadequacy of stimulus from inadequacy of response. The inadequacy of response is made up of paucity of ideas, defective apprehension, an inability to concentrate, poorly developed general intelligence, and abnormal affects.

The remarks on sterilisation are very guarded, and we only wish that other writers on this vexed subject would weigh their evidence as carefully as he does. It is wisely pointed out that sterilisation, to have any value, would have to be compulsory. The majority of defectives are not the offspring of people themselves defective, so that compulsion would be a difficult matter. Segregation, although it may be an expensive matter, is of considerably greater value as a matter of practical politics.

The author's plea that mental defectives should be brought within the provisions of the Mental Treatment Act, 1930, has a great deal to commend it, and is a move in the right direction.

*Difficulties of the Evolution Theory*. By Douglas Dewar. Pp. viii + 192. (London: Edward Arnold and Co., 1931.) 12s. 6d. net.

A LABORIOUS anthology of facts which have not been completely elucidated by evolutionists, leading up to the conclusion that new forms of life arise by creation and may be afterwards modified, in minor respects, by gradual evolution. The following is a novel contribution to the anti-evolutionist case. "Another feature not easily reconciled with the evolutionary theory is the great disparity in the span of life of various animals. If every organism be descended from a common



ancestor, would such enormous differences exist? Why should a parrot live to over 100 years while the pheasant apparently does not live longer than 15 years, why should an elephant live for as much as 120 years, while no rhinoceros is known to have lived more than 37, and no hippopotamus more than 33 years, why should the cat live three times as long as the guinea-pig? As the vast majority of individuals in a state of nature are killed long before they have reached their full span of life, and as species the members of which are long-lived do not seem to be more flourishing than those of which the members are short-lived, it does not seem possible that the disparity in longevity has arisen as a result of natural selection. If, however, the various types have been created independently, we should expect this disparity in the span of life, because the *raison d'être* of these types is the stocking of the earth with a great variety of forms, and length of life is a characteristic that offers ample scope for variety. In an appendix, the author discusses at length "The alleged origin of mammals from reptiles", without once mentioning the ear-ossicles.

G. P. W.

*Industrial Microbiology the Utilization of Bacteria, Yeasts and Molds in Industrial Processes* By Prof H. F. Smyth and Prof W. L. Obold. Pp. x + 313 + 3 plates. London (Baillière, Tindall and Cox, 1930) 27s net.

THIS book is devoted to an account of the ways by which industry has utilised the chemical activities of bacteria, yeasts, and moulds. It is divided into twelve sections, beginning with accounts of the production of carbocyclic acids, alcohols, and ketones, and followed by a discussion of the way in which carbohydrates, such as cotton, hemp, jute, cellulose, etc. are by microbiological activities dealt with in industry. Further sections on the production of foods and other commercial products complete the volume. The general purpose of the book is to bring before manufacturers, and students thinking of entering this field of work, the information already available but scattered through a wide field of scientific journals and technical publications. On the whole, the authors have done their work fairly well, though their spelling and structure of sentences leave much to be desired. Their decision to make the bibliography a selected one and not complete is wise, since the uninitiated student with a long list of references before him is apt to waste a good deal of time reading unnecessary papers before reaching the ones that are of real importance to his subject.

- (1) *The Children we Teach Seven to Eleven Years* By Dr Susan Isaacs. Pp. 176 (London University of London Press, Ltd., 1932) 3s 6d net.
- (2) *Education of the Backward Child* By David Kennedy-Fraser. Pp. 254 + 4 plates (London University of London Press, Ltd., 1932) 6s net.

THE reason why we mention these two books together is that they both bear upon the problems of education, and the reason why we mention them

at all is that they are both examples of scientific method in the field of educational inquiry. The older philosophic method of approach to psychological questions is well known to have been to a great extent replaced by a scientific method of approach. The same may be said of the serious study of education. This used to be the business of the philosopher and of the psychologist who drew his inspiration from philosophy. Now the serious study of education is also undertaken by modern psychologists like Dr Susan Isaacs and Dr Kennedy-Fraser, both of them well equipped for the respective tasks undertaken in these two books. (1) Dr Isaacs writes simply, but with the simplicity of one who knows the complexities also, about normal children of the junior school age. The subject is a timely one, and for most parents and teachers there is a message on nearly every page of her book. (2) Dr Kennedy-Fraser has made a study of the backward child, who may be backward in a temporary or in a permanent sense, and is not to be confused with the mentally defective child. The backward child, as here defined, has not received the attention that he deserves, whether from administrators or from psychologists. This book helps to fill a gap in our educational literature.

*Handbuch der Pflanzenanatomie* Herausgegeben von Prof. K. Linsbauer. Lieferung 28. Abteilung 2, Teil 2. *Bryophyten*. Band 7/1. *Anatomie der Laubmoose*. Von Wilhelm Lorch. Pp. viii + 358 (Berlin: Gebrüder Borntraeger, 1931) 37 50 gold marks.

THE new volume in Linsbauer's "Handbuch der Pflanzenanatomie" on the anatomy of mosses, by Wilhelm Lorch, gives a useful survey of the literature on the subject, but the striking feature of the volume is the amount of original work contributed by the author. Results of previous workers have been reinvestigated, new facts added, and the majority of the very numerous text figures are original.

The text reveals that development has been followed in considerable detail, from this, points of interest emerge with regard to the behaviour of the adult tissues. For example, it is stated that the rupture of the calyptra from the vaginula takes place in the region of the last division in the intercalary growth of the archegonium, which follows fertilisation of the ovum. The interesting section on peristome development also is suggestive that the order of divisions in the meristem is most important, and one regrets that the figures of the developmental stages do not give a rather clearer picture of the condition of the cells in the various regions at different times.

The section on the chemistry shows that cellulose is the usual basal substance of the walls, though this is often masked by impregnation with tannins or other substances. In relation to the ease with which water is taken up by almost any part of a moss, it is also of interest to find that the presence of an appreciable cuticle has been confirmed for a considerable number of species.

## Structure of Atomic Nuclei

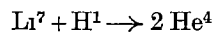
TO give a report of a discussion on a subject so complicated as the physics of the nucleus would be an arduous task at any time, but when it is an occasion for dealing with two new discoveries, it is a task the difficulty of which is sufficient excuse for any shortcomings. Not only did Dr J Chadwick describe his experiments leading to the identification of the neutron at the discussion on the subject at the Royal Society on April 28, but also Lord Rutherford reported that Dr Cockcroft and Dr Walton, working in the Cavendish Laboratory, had succeeded in effecting the artificial disintegration of several elements with protons from a high potential discharge tube.

The discussion was opened by Lord Rutherford in a characteristic address. Referring briefly to a number of different subjects, he showed convincingly how rapidly the subject of nuclear physics has extended in recent years. There is now a variety of lines of attack upon what he has appropriately termed the central problem of physics. Optical methods have been shown to lead to information about the masses of isotopes and the type of statistics they obey, while the details of the hyperfine structure give a direct measurement of the nuclear spin. Radioactivity has shown itself capable of revealing new details about the heaviest nuclei, and a close investigation of the  $\alpha$ -rays has thrown new light on the origin of the  $\gamma$ -rays. Quite apart from the information they yield about the nuclei from which they originate, the  $\gamma$ -rays and  $\alpha$ -rays have proved as useful in recent years as in the past for investigating the fundamental laws governing high frequency radiation and high speed particles. A new type of absorption of electromagnetic radiation by the nucleus has been brought out by the work of Meitner, Hupfeld, Tarrant, and Gray, which the last two workers believe to involve a true excitation of the nucleus.

In the more colloquial sense, however, it is in the field of artificial disintegration that the most exciting results have been obtained. A great deal of work has been carried out in different laboratories recently on the production and control of high voltages, and Cockcroft and Walton, working in the Cavendish Laboratory, have developed the technique of producing and using steady high potentials so high as 600,000 volts. They investigated the effect of bombarding lithium with protons of a few hundred thousand volts, and found the striking result that the lithium nucleus can absorb the proton and break up into two  $\alpha$ -particles, each of which recoils with an energy corresponding to more than eight million volts (NATURE, April 30, p. 649).

The experiments are simple in principle even if the technique is difficult. By means of a specially built discharge tube, protons are accelerated up to energies of several thousand volts. They are allowed to fall on a screen covered with lithium, to the side of which, and just outside the tube, is placed a zinc sulphide screen. A window covered

with thin mica is arranged in the side of the tube, so that particles coming from the lithium can, if they have sufficient energy, reach the zinc sulphide screen. It was known from previous measurement that the protons themselves had not sufficient energy to penetrate the mica and reach the zinc sulphide screen, even if they were reflected from the lithium oxide without loss of energy. Bright scintillations were observed in the zinc sulphide as soon as the energy of the proton beam exceeded 120 thousand volts, and the numbers of these scintillations increased very rapidly as the voltage was raised. The particles causing these scintillations had a range in air of about 8 cm, whereas the protons responsible for their emission could only penetrate about 1 cm. This simple fact alone is a definite proof that disintegration involving a large emission of energy had occurred. The general character of the scintillations, coupled with the range of 8 cm, suggested that these particles were  $\alpha$ -particles, and this was borne out by the nature of the tracks obtained in an expansion apparatus. The process is therefore imagined to be

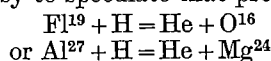


From Aston's accurate measurements of the masses of these atoms, it follows that there would be a liberation of from 15 to 17 million electron-volts of energy in this process, in excellent agreement with the energy of  $8 \times 10^6$  electron-volts which helium nuclei need in order to have a range of 8 cm. While it therefore seems almost certain that this is a correct description of what is happening, Cockcroft and Walton were careful to emphasise that the nature of the high speed particle liberated in the disintegration had not yet been definitely established. Additional evidence will be provided if it is possible to show, as would follow from this hypothesis, that the particles always occur in pairs travelling in opposite directions.

The magnitude of the effect may be illustrated by the following figures. The effect becomes appreciable once the proton beam is accelerated with more than 120 thousand volts, and at 250 thousand volts one disintegration particle was obtained for about every  $10^9$  protons hitting the lithium. The tube could be run at several microamperes, and since one microampere corresponds to about  $10^{13}$  protons per second, it is clear that even with small solid angles there are plenty of particles to detect. Herein lies one of the important advantages of this new method. The yield of disintegration particles obtained even with the eight million volt particles from radioactive bodies is only of the order of one millionth, and it is a very powerful radioactive source which emits  $2 \times 10^9$   $\alpha$ -particles per second, and those in all directions. It is easily seen that, despite the inefficiency of these low velocity protons, the actual number of disintegrations that can be effected is very much greater than with particles of radioactive origin, due to the large number of protons that can be used.

In still another direction this discovery is of importance, since it gives a different type of nuclear disintegration. Using  $\alpha$ -particles, it has been found that a proton is ejected and the  $\alpha$ -particle is captured, forming an atom of greater mass. If protons cause a disintegration, they must form an atom of smaller mass and lower in the periodic system.

Similar experiments have been tried with other elements, and it has been found that beryllium, boron, carbon, possibly nitrogen, fluorine and aluminium all give particles of characteristic range and of greater energy than the incident protons, oxygen and copper gave no effect. While disintegration occurred with both boron and aluminium with protons of energy so low as 150 thousand volts, with the other elements it was necessary to go to more than 300 thousand volts before noticeable effects were produced. It would therefore seem that the greater majority of the lighter elements can be disintegrated by bombardment with protons. While it is easy to speculate that processes such as



may occur, there is as yet no evidence about the nature of the particles except that which has been described in the case of lithium, and conclusions of any kind are mere guess-work until more information has been obtained.

Dr Chadwick began by describing the results that have been obtained from investigating the collisions of  $\alpha$ -particles with the nuclei of the lighter elements. Scattering experiments on one hand, and artificial disintegration experiments on the other, have combined to yield a wealth of information that could scarcely have been anticipated a few years ago. If these experiments of Chadwick and others are not discussed here, it is not because of any lack of recognition of their fundamental importance and interest, but merely to come more quickly to Chadwick's discovery of the neutron.

Bothe and Becker first noticed that a very penetrating radiation was emitted when beryllium was bombarded with  $\alpha$ -particles. Working with this beryllium 'radiation' and using an ionisation method, Joliot-Curie and Joliot found the surprising result that protons were ejected when it passed through materials containing hydrogen. If, as had always previously been supposed, this beryllium 'radiation' was of electromagnetic nature, the quantum would have to have an energy of  $50 \times 10^6$  volts to account for the observed range, 30-40 cm in air, of the protons. In addition, it was particularly difficult to understand how the absorption process could occur so frequently.

Chadwick investigated this phenomenon, using the powerful valve counter methods which had been developed in the Cavendish Laboratory, and found some most surprising results. It appeared that this beryllium 'radiation' liberated particles from all light elements through which it passed, but if these processes were held to be due to interaction with some electromagnetic radiation, the quantum had to be  $100 \times 10^6$  volts from the results with nitrogen,  $150 \times 10^6$  volts from argon, whereas the value  $50 \times 10^6$  volts was obtained from experiments

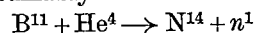
with hydrogen. Chadwick realised that these difficulties disappeared if the beryllium 'radiation' were assumed to be of corpuscular nature, and then the particles detected by the valve counter would be atoms of the material radiated set in motion by collision with these corpuscles.

Now the beryllium 'radiation' is extremely penetrating, it loses less than one-half of its intensity in passing through one inch of lead, so that if it is corpuscular, then the corpuscles must be only very slightly affected by the atoms through which they pass. This can only mean that the field of influence of these corpuscles is limited to a minute space around them, and that they can pass close to an electron or nucleus without disturbing it or giving energy to it. A neutron, that is a proton and electron in close combination, would have just such properties, and, moreover, if its mass were about unity, and its velocity sufficiently high, it could set other atoms in motion on the rare occasions of direct collisions with the nuclei.

Important confirmation of the correctness of these general ideas was furnished by experiments in which the beryllium 'radiation' was passed through nitrogen contained in an expansion chamber. While no tracks were found corresponding to the neutron itself, clear photographs were obtained of nitrogen recoil atoms set in motion by the process already described. Chadwick has produced convincing evidence of the accuracy of this hypothesis by the following arguments based on his experiments. From measurements of the ranges, he determined the maximum velocities  $u_{\text{H}}$  and  $u_{\text{N}}$  which hydrogen and nitrogen nuclei could acquire by collision with a neutron. This evidently occurs in a head-on collision, so that if  $m$  and  $v$  denote the mass and velocity of the neutron, it follows from the conservation of energy and momentum that

$$u_{\text{H}} = \frac{2m}{m+1} v \\ u_{\text{N}} = \frac{2m}{m+14} v$$

Inserting the experimental values, he obtained a value for  $m$  slightly greater than unity, and a velocity about  $3 \times 10^9$  cm per second. He obtained a far more accurate estimate of the mass of the neutron from a consideration of its origin. Chadwick and also Joliot-Curie and Joliot had discovered that neutrons are liberated from boron as well as from beryllium. In the former case the process is presumably



where  $n^1$  denotes the neutron of mass about unity. Aston has made accurate measurements of the masses of boron, helium, and nitrogen, so that utilising the connexion between mass and energy given by the relativity theory, the energy balance of the process can be examined. It is found, taking into account the kinetic energy of the  $\alpha$ -particle, that the velocity of the neutron, obtained by the method already mentioned, can only be accounted for if the mass of the neutron lies between 1.005 and 1.007. Since the mass of a free hydrogen atom is 1.0078, it follows that the energy of binding of



hydrogen. The oils are distilled, and the heavier fractions used for pasting the coal. The petrol obtained requires only a slight purification treatment prior to use.

The intermediate oils are passed to a vapour-phase converter, where further hydrogen is added, and the mixture of hydrogen and oil vapours is passed over a catalyst, a petrol is obtained from this vapour-phase hydrogenation product by distillation after reduction of pressure. The residual oil obtained in this phase may be re-cycled, or may be sold as diesel oil. The heavy oil residue from the first converter can be blown out, and the liquid product recovered, the residue from which is a solid

coal consumption is therefore 3.15 tons (reckoned dry and ash-free), or 3.65 tons of actual coal, per ton of petrol produced. The overall thermal efficiency is 43 per cent, as will be seen in Fig. 4.

The figures for cost given by Imperial Chemical Industries, Ltd., now work out at about 7d a gal., of which 2d is the cost of the coal. It will be seen that this petrol cost is actually less than the present duty, so that at the moment, in a plant of sufficient size, petrol from coal could compete very easily with petrol from foreign sources. Some time ago I was given an opportunity of examining both the technical and financial sides of the Billingham plant, and although at that time so low a figure as 7d a gal. had not been reached, it was already evident that 8d or 9d a gal. would not be exceeded.

#### HYDROGENATION OF TAR

The treatment of high and low temperature tar by hydrogenation is another method of producing from home sources a supply of motor spirit. Work on this subject has been carried out by Ormandy and Varga, and at the Fuel Research Station. The Gas Light and Coke Co. is also investigating the method in order to find a more favourable market for certain of its tar fractions which are at present almost a drug on the market. A small

continuous plant for the hydrogenation of tar has been erected at the Fuel Research Station. The low temperature tar obtained by carbonising coal at 700° C. with 10 per cent steam has been treated in this plant, 150 gal. of motor spirit and 65 gal. of diesel oil were obtained per ton of low temperature tar treated, whereas by straight distillation the corresponding figures would be 15 gal. of motor spirit, 117 gal. of heavier oils, and 884 lb. of pitch.

#### MECHANISM OF THE HYDROGENATION REACTION

Much further experimental work will be needed to explain the precise effect of hydrogenation on the various constituents of coal, crude oil, or tar, which are all very complex substances, but we already know that the hydrogenation action is a progressive one. When coal is subjected to hydrogenation, the first action is that it becomes plastic, and if hydrogenation is stopped at this stage a pitch-like material is obtained. If a non-coking coal is mildly hydrogenated, it is converted into a material possessing marked coking properties, and so we have for the first time the possibility of converting non-coking coal into coking coal, which, it must be admitted, is not at present an attractive commercial proposition.

An interesting paper describing investigations into the "Thermal Decomposition of Hydrocarbons", namely, methane, ethane, ethylene, and acetylene, was given by Bone and Coward to the Chemical Society in 1908. The character of the products formed when these gases were heated, either alone or in the presence of hydrogen, was examined, and it was concluded that "in the cases of ethane and ethylene, it may be supposed that the primary effect of high temperature is to cause an elimination of hydrogen with a simultaneous loosen-

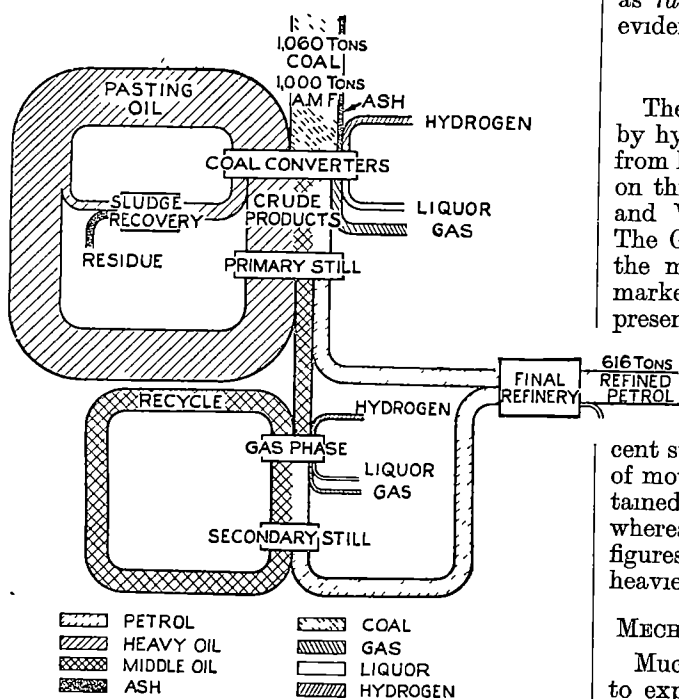


FIG. 3.—Diagram showing ingoing and outgoing products in a hydrogenation plant of 1000 tons a day.

material containing ash, together with some 5 per cent of the original coal, it could be used only under the boilers. A diagram showing the ingoing and outgoing products in a plant designed for the hydrogenation of 1000 tons of coal a day is shown in Fig. 3.

By re-cycling, etc., in the plant at the Fuel Research Station, some 140 gal. of motor spirit per ton of coal as charged could be obtained, but this has been appreciably exceeded in the large-scale Billingham plant. In this, 100 tons of coal reckoned on the dry, ash-free basis) is capable of yielding 62 tons of petrol and 28 tons of gas, leaving a residue of about 6 tons of partially converted material. The gas can be used for hydrogen manufacture, and the residue for firing boilers.

For each ton of coal hydrogenated, a further ton is required for raising steam for hydrogen manufacture and power generation, and for making the producer gas required for the process. The overall





gaseous products finding their normal markets, the coke is then subjected to the water-gas process so as to produce a mixture of carbon monoxide and hydrogen. By the use of various catalysts, together with, if necessary, additional hydrogen, liquids of various types are obtainable. Such catalytic conversion has been investigated in Germany by Fischer and the Badische Anilin und Soda Fabrik, in France by Patart and his co-workers, and in England by Prof G T Morgan at the Chemical Research Laboratory, by Prof W A Bone at the Imperial College of Science and Technology, and by Imperial Chemical Industries, Ltd. Dr Franz Fischer, of Mulheim, working at atmospheric pressures, has produced liquid and solid hydrocarbons of the petroleum series. Oxygen-containing products are absent, and a yield of 100 gm of solid, liquid, and liquefiable hydrocarbons is claimed from each cubic metre of water-gas.

#### CONCLUSION

On the technical side much has been achieved. By the carbonisation of coal, liquid products suitable for use in internal combustion engines or in furnaces can be obtained directly, but not in large quantities compared with the amount of coal used,

in such processes the greatest stress must be laid upon the markets for the solid and gaseous products, oil and petrol being merely by-products. By the hydrogenation of petroleum, or of low temperature tar and certain fractions of high temperature tar, large percentage yields of motor spirits can be obtained.

By the direct hydrogenation of a suitable coal some 160 gal of motor spirit per ton of coal treated can be made, and even when the additional coal for the process is taken into account the yield is 80 gal and the thermal efficiency is 43 per cent. Alternatively, motor spirit can be obtained synthetically either in the form of alcohols or of hydrocarbons, by first converting the coal into carbon monoxide and hydrogen, but not, under present conditions, so cheaply as by hydrogenation.

In view of the mechanical difficulties of working, on a large scale, a process involving simultaneously high pressures and high temperatures, the technical progress of coal hydrogenation has been surprisingly rapid. It is now undoubtedly possible to manufacture petrol from coal. The commercial prospects of the process are, nevertheless, uncertain, for it is always difficult to forecast the future of a synthetic, in competition with a natural, product.

### The Royal Academy

ENTERING the galleries of Burlington House with a mandate to seek for "points of particular scientific interest", I went first to the Sculpture Rooms, where my attention was arrested by the bust of Sir Patrick Geddes (1427), whose recent death has left a gap in the ranks of science which will not easily be filled. The character which emerges in Mr Pibworth's rendering is that of the acute analytical mind, the contemplative philosopher does not appear. It is interesting to consider in this connexion the appreciations which have appeared in the Press from a number of Geddes's friends, each reflecting a different facet of his many-sided mind. His influence in the world was undoubtedly due in large measure to the great variety of persons with whom he was able to make sympathetic contact.

The full-size model of the Native War Memorial, Lagos (1382), by Mr James A Stevenson, admirably illustrates the statuesque character which is so marked in many of the African peoples. I suggest that such successful generalisation of the attributes of existing races is of "more particular scientific interest" than the emphasis of simian characters, now so popular, which inevitably suggests the 'missing link' as the true ideal of the human form.

Among the oil paintings, well placed at the end of Gallery II, "Spoleto, Italy" (103), by Mr Osmund Pittman, is a fine composition, showing the hill town above a river spanned by an arched bridge (the water reflecting the colour of the sky), the architectural forms pleasing in the simplicity common to Mediterranean building, with plain plastered wall, small windows, low roofs, and ab-

sence of chimneys. In "Old Mill House, Avila, Spain" (150), by Mr Oliver Hall, R A, severity of architecture and a stern landscape are in fine accord, and the scheme of tone and colour is skilfully continued in the design of frame which this painter habitually employs.

"Last Rays Northern Ireland" (194), by Mr Julius Olsson, R A, is one of those studies of sunset colour upon the sea which cannot be too often repeated, for the effect is as fleeting as it is beautiful. Mr S J Lamorna Birch has a study of the columnar granite cliffs of the Land's End (225) rising from smooth, flat sands, across which the long, low waves come gliding in. "Harbour" (262), by Mr George Graham, recalls for our pleasure the perfection with which the forms of hull and sail, of spars and rigging, are outlined by the plain background of water and sky in the estuaries of a low-lying shore.

Mr Joseph Farquharson, R A, has a most poetic study of the stately columns of a fir forest among the mountains (339), with solemnity of deep, rich colour.

Mr Guy Kortright's "Springtime in Dalmatia" (557) and "August Heat Corsica" (623) are remarkable studies in the essential forms of the land, although not, I think, equally successful in conveying the transitory qualities of the seasons. "Twilight in the Downs" (604), by Mr William Clarkson, renders in a harmony of tones the mystery of the dying day.

Among the water-colours, Mr Frank Baker's "Widcombe-in-the-Moor" (781) gives us the ever-welcome scene of church and hamlet backed by swelling hills, seen in the soft sunshine of the

English summer In Gallery No VI, Mr Samuel Smith's dry point of "Richmond Castle, Yorkshire" (1165), is a fine study of architecture set between the water and the sky

The Architectural Room provides much food for thought. Looking at the dignified and harmonious designs of residential and business blocks

in framework of steel, we wonder why the appearance of our great cities is not more pleasing, and are impelled towards the hopeful conclusion that the source of our present discontent is the mixture of the cubical with the older, gabled forms; and that all may once more be well when the new pattern has complete possession VAUGHAN CORNISH

## News and Views

### Georges Cuvier

ON May 13 occurs the centenary of the death of the distinguished French naturalist and statesman, Baron Cuvier, often referred to as the founder of comparative anatomy "It was", says von Zittel, "the creative genius of Cuvier that erected Comparative Anatomy into an independent science, and defined principles upon which the investigation of fossil Vertebrates could be carried out with accuracy

... His greatness rests upon the magnificent work that he accomplished in the domain of Vertebrates, upon the scientific method which he founded for the identification of fossil bones, and upon his successful demonstration that the primeval mammals were not mere varieties of living forms, but belonged to extinct species and genera" Moreover, Cuvier, by his skill as a lecturer and writer and by his commanding personality, attracted many to the study of geology and palæontology, while, as one of the inspectors appointed by Napoleon to reorganise the schools and colleges of France and other countries, he did much to introduce and extend the teaching of natural history and other sciences

CUVIER, who was made a baron in 1819, was born on Aug 23, 1769, at Montbéliard, then belonging to the Duchy of Wurtemberg, his full name being Georges Léopold Chrétien Frédéric Dagobert Cuvier A child of unusual gifts, he received his earliest education from his mother, but at the age of fifteen years became a student at the Academy of Stuttgart, and at nineteen was a tutor in a nobleman's family in Normandy Here he passed the years of the Revolution, little affected by the events of the time, but meanwhile extending his knowledge of natural history The turning point in his career came with his friendship with the Abbé Tessier, through whom he went to Paris, where he quickly attained to a distinguished position In 1795 he was given a post in the Museum, in 1796 was made a member of the Institut de France, in 1800 he succeeded Daubenton at the Collège de France, and in 1803 he was made permanent secretary to the Academy of Sciences. His works included his "Leçons d'anatomie comparée" (1801-5), "L'Anatomie des mollusques" (1816), "Le Règne animal" (1817), "Les Ossements fossiles de quadrupèdes" (1821-24), and his uncompleted "Histoire naturelle des poissons" His *éloges*, published in three volumes, included those on Priestley, Banks, Delambre, Berthold, Lapeyère, and Davy For some years he was Chancellor of the University of Paris, and both under Napoleon and his successors he held high State appointments His

death was regarded as a national calamity, and his burial in the Père la Chaise cemetery was attended by a large concourse of people

### Portraits at the Royal Academy

IN addition to the paintings and other studies at the Royal Academy mentioned by Dr Vaughan Cornish in his article published elsewhere in this issue, the exhibits include portraits of the following Dr Alfred Cox, medical secretary to the British Medical Association, 1912-32 (190), by Sir Arthur Cope, Dr Thomas Sinclair, M.P. for the Queen's University of Belfast (210), by Mr George Harcourt, Prof Blair Bell, of the University of Liverpool (261), by Mr John A A Berrie, Prof R S Troup, director of the Imperial Forestry Institute, Oxford (332), by Mr Peter A Hay, Sir Robert Witt, vice-chairman of the Institute of Industrial Psychology (377), by Mr Oswald Birley, Dr W W Vaughan, headmaster of Rugby School, 1921-31 (398), by Mr Glyn Philpot; Mr F Howard Livens, vice-president of the Institution of Mechanical Engineers (447), by Mr Arthur G Walker, Dr Bevan Lean, headmaster of Sidcot, Somerset, 1902-30 (542), by Mr Bertram Priestman, Lieut-Gen the Right Hon J C Smuts, president in 1931 of the British Association (594), by Mr John Wheatley Among the statuary we notice Sir Ernest Shackleton (1390), statue, and Lord Melchett (1392), relief, both by Mr Sargeant Jagger, Sir Ambrose Fleming, emeritus professor of electrical engineering in the University of London (1492), bronze bust, by Mr George H Paulin, Sir Jagadis Chandra Bose, director of the Bose Research Institute, Calcutta (1564), bronze head, by Marguerite Milward

### Science in Drama

THE need for men of science to appreciate the sociological consequences of their work, alongside the equally vital necessity for politicians to realise what science opens up in the field of social and industrial reconstruction, have often been stressed in these columns. It is, therefore, with much interest that we note the production at the Globe Theatre, London, of "Wings over Europe", by Robert Nichols and Maurice Brown The authors avail themselves of a legitimate poetic licence A young and brilliant scientific worker with a rather simple sociological outlook discovers how to release the energy of the atom, and offers to present his discovery to the British cabinet, provided the cabinet will at once take such steps as should now be possible to eliminate poverty and reduce all work to the barest minimum The confusion and despair of a cabinet of men ignorant

of the elements of science and wedded to traditions that are now doomed is well portrayed, if rather exaggerated. That such a theme can find its place successfully on a London stage is significant of the fact that the importance of science as an unconscious revolutionary factor in society is beginning to be appreciated.

#### Scientific Precision and Popularisation

WHY is it that, in a certain class of publication aiming at popularity, vagueness seems to be considered essential in attracting the interest of the general public? It appears particularly in relation to geographical and ethnographical details. We have before us two small volumes from a series with many pleasing features, "Things Seen by the Camera" (London: George Routledge and Sons, Ltd., price 2s. 6d. net each). Of these, each contains sixty-four photographic reproductions. One deals with China and the Chinese, and another with the natives of Africa. The latter is concerned exclusively with physical types and covers a fairly representative range, some evidently chosen to demonstrate peculiarities of dress or physical deformation, such as the distension produced by the woman's lip-ornament. The volume dealing with China, in addition to characteristic or peculiar types, includes scenes from Chinese life and examples of Chinese buildings and architecture. It often happens that material of this kind is collected by those who have lived in out-of-the-way parts of the world and are not in touch with scientific bodies. They put their material in the hands of agencies, which distribute it to the popular Press, but through inadequate description, material which might be of value to the scientific worker not infrequently loses its utility. In fairness to the two publications before us, it must be said that in most instances they give an approximate or precise attribution. But if in one case, why not in all? "Witch-doctor from Central Africa", "Native Girl from Rhodesia", says little. The popular attraction of the picture could not possibly be affected by the addition or omission of the name of the tribe in brackets.

#### Britain's Contributions to World Progress

In a thoughtful essay entitled "The Projection of England" (London: Faber and Faber, Ltd., 1s.), Sir Stephen Tallents reminds us of our heritage of greatness in most fields of thought and activity, and points out that in the modern interdependence of nations, England can no longer afford to pursue a policy of standing aloof from the rest of the world. He indicates some of the attainments of the British in the fields of science and industry, and reflects that these are too little known to other nations. England neglects many opportunities of making herself known abroad, and of communicating her knowledge and discoveries to a wider world. In short, while he deprecates any form of national boasting, Sir Stephen Tallents argues that we need to develop "a continuous and sustained presentation of our industrial ability and our industrial ambitions through every available channel of communication open to us".

For this purpose, well-executed films are indispensable, but Sir Stephen presses for the art of national projection in a metaphorical as well as a literal sense. His proposal is that we should have a school of national projection—not as a government department, but rather as the result of private munificence—that must study national characteristics and achievements and lose no opportunity of suitably presenting these as records of fact to the wider world, through the medium of Press and poster, films and wireless, exhibitions and conferences. In these forms of enterprise, he complains that Britain has fallen behind some of the other great States of the world.

#### Trevithick's First Rail Locomotive

ON April 27, simultaneous meetings of the members of the Newcomen Society were held in London and New York. At both places, two papers were read, the first being by Mr. W. W. Mason on Trevithick's first rail locomotive, and the second by Mr. C. L. Chandler on early shipbuilding in Philadelphia. As the centenary of the death of Richard Trevithick would be commemorated next year, it seemed desirable, said Mr. Mason, to determine, so far as possible, the truth about the locomotive Trevithick built in 1803 and with which he experimented in South Wales in the early part of 1804. Neither the account of the experiment in Francis Trevithick's "Life" of his father nor those contained in other works agree as to the design of the engine, while there are discrepancies in the drawings in existence. One account, for example, says the cylinder was placed vertically within the boiler, while Llewellyn's drawing, preserved in the Science Museum, shows the cylinder horizontal. But this is only one point which calls for further investigation. Whatever doubt may exist as to the arrangement of the engine, however, there is little question that on Feb. 21, 1804, it took a load of 10 tons of bar iron and about 70 passengers from the Penydarran works, where it was constructed, down the old tram-road to its junction with the Glamorgan-shire Canal at Abercynon, a distance of about 10 miles, and in March repeated the journey, but with a net load of 25 tons. One of the most versatile inventors of his age, Trevithick was a pioneer in the use of high pressure steam, and by his experiment in 1804 he became the father of the steam locomotive.

#### Broadcast Reception in the United States

IN *World Radio* for April 15 there is an interesting account of a motor tour by R. M. Bell in the United States with a portable receiving set. As good highways connect all parts of the country, the 3000-mile trip from the Atlantic seaboard to Los Angeles can be made quite easily. The tour brought within daylight range most of the American stations. In Chicago the 25 local stations made it difficult to hear outside stations. Doubtless the same difficulty arises in New York, which has 43 local stations. Near Chicago, a relay from Poznań came through in excellent volume. There are nine television stations at present 'on the air'. Chicago uses 45 lines per picture and 15 pictures per second, New York uses

60 lines and 20 pictures per second. In Los Angeles, the 17 local broadcast stations, several of which are 'on the air' for 24 hours daily, made reception from other cities practically impossible, but a number of international relays from abroad were heard from them. The B.B.C. orchestra was heard as distinctly as it is in London. When passing through the Japanese and Mexican portion of the city, the street resounded with a speech from Berlin. In Tennessee, near Nashville, Los Angeles, 1775 miles to the west, and New York, 775 miles to the east, could be heard easily on the portable receiver. The writer mentions that Los Angeles (KFI), Dallas (WFAA), and Cincinnati (WLW) transmitted splendidly. In daytime they could be heard at a distance of 300 miles in good volume, and at night at distances of more than 1000 miles. When he got back to Pennsylvania, he heard at 7 A.M. the toasts given at the Lindbergh banquet at Tokyo (9 P.M. in Japan) being relayed from the local networks.

#### Ultra-short Wave Television

A SUCCESSFUL public demonstration of ultra-short wave television was given on Friday, April 29, at Messrs Selfridges' stores in Oxford Street, London. The transmitter was situated on the roof of the laboratories of Baird Television, Ltd., in Long Acre, W.C.2, the wave-length used being 6.1 metres. The ultra-short waves have the advantage over medium wave-lengths that they allow television pictures of much finer detail to be transmitted, and provide a reliable local service free from fading and atmospheric disturbances. An interesting feature of the transmission was that although sent out on ultra-short waves, the images could still be received easily by possessors of the ordinary Baird 'Televisor' and wireless sets of normal type designed for the present B.B.C. television transmissions. To do this, the only extra apparatus required was an ultra-short wave adaptor, which virtually converts any normal receiver into a super-heterodyne. The demonstration given on April 29 is the first public demonstration of the possibilities of ultra-short wave television to be given anywhere in the world, and marks a further stage in the development of the art.

#### Developments in Methods of Communication

A PAPER on modern communication systems, by Dr F. Luschen, was read to the Institution of Electrical Engineers on April 7. Dr Luschen pointed out that the rapid progress of invention has made modern communication systems very complicated to design. Few realise how difficult it was to solve the problem of the interconnexion of wired and wireless systems. This was first carried out in the telephone link between Great Britain and the United States. Further problems that have been solved are the multiple utilisation of lines for telegraphy and telephony, the control of electrical apparatus at a distance, and the electro-acoustic transmission problems involved in broadcasting and sound-films. These methods have widely extended the field of use of communication systems. The information

contained in the spoken word is an extremely complicated function of the time. The transmission system is composed of widely different elements. At first, therefore, it appears to be a hopelessly difficult problem. Yet, with the help of a few simple mathematical principles, engineers have succeeded in visualising the transmission of signals. As an illustration of the pitch of perfection to which carrier-current telephony has reached in the United States, Dr Luschen described a pole line carrying twenty pairs of conductors, sixteen of which carry three high frequency channels each, in addition to their low frequency communication circuits, while the other four pairs are equipped with ten telegraph channels each. Twenty pairs of wires thus result in 150 communication circuits, 80 of them being telegraph circuits and 70 of them telephone circuits. Dr Luschen also gave interesting particulars of tests made on a system of telephony and telegraphy linking Berlin with Buenos Aires. It is designed to transmit speech and two telegraphic messages simultaneously.

#### Rival Theories of Hearing

IN his Royal Institution discourse on Friday, April 29 on theories of hearing, Prof. H. Hartridge reminded his listeners that rivalry still exists between the theories of hearing, because the small size, the delicacy, and the inaccessibility of the internal ear make direct observation and experimentation well-nigh impossible. Some of the rival theories are the telephone theory, the modified telephone theory of Boring, the modified telephone theory of Watt, the volley theory of Wever and Bray, the pattern theory of Ewald, the stationary wave theory, and the resonance theory. At the present day, controversy principally centres round the resonance theory and some form of telephone theory. The production of deafness over a narrow range of frequencies, by surgical interference with a part of the internal ear, is accounted for more readily on the resonance theory than on the rival theory. The same may be said of boiler-makers' deafness and its experimentally produced counterpart. When physical tests are applied to hearing, evidence is obtained in each case in favour of resonance and contrary to telephony. The universal acceptance of the resonance theory is delayed by various criticisms, which arise in most cases from unfamiliarity with the behaviour of resonators and sense organs. The resonance theory accounts satisfactorily for all the phenomena, and no other theory does this.

#### Purpose in Evolution

IN the Riddell Memorial Lectures for 1931, delivered before the University of Durham at Armstrong College, Newcastle-on-Tyne, Sir J. Arthur Thomson discussed the general subject of "Purpose in Evolution" (Oxford University Press, 1932, pp. 59, 2s. 6d. net). The opening lecture examined various aspects of Nature in view of the question: Is there a purpose in evolution? It grants that often the development and ways of acting of living units are purposive, and comes to the conclusion that the scientific facts do

suggest the interpretation that Nature expresses a purpose, and that since the scientifically known system of Nature, being largely unconscious, cannot be credited with a purpose, we are led to think of a Creator's purpose. The fact that the scientific ideal is limited to a naturalistic description does not in the least imply that we need refrain from idealistic, transcendental, mystical, or religious interpretation—the only kind of interpretation there is. The second lecture dealt with the disharmonies in Nature and the difficulties to which they give rise in the teleological interpretation of a Creator's world, but such disharmonies, often exaggerated, need not obscure the greater fact of an overriding harmony. The final lecture, on "Lessons from Evolution", based on the fact of a real progress in organic evolution, is a plea for a ranging of human endeavour in line with the trends which have been conspicuously progressive in the re-human ascent of life.

#### Control of Canadian Insect Pests

THE Canadian Government and the Empire Marketing Board are jointly financing a search in Europe for the parasites of certain Canadian insect pests. The Canadian Department of Agriculture has asked the help of the Parasite Breeding Laboratory at Farnham Royal, Bucks, which is maintained by the Empire Marketing Board, in combating the present severe outbreak of a forest insect, *Diprion polytomum*, and also in fighting the plague of balsam woolly aphis, which is causing serious injury to balsam fir in the Maritime Provinces. If the balsam woolly aphis infection spreads throughout the eastern forests, as it threatens to do, enormous losses in pulpwood will result. The only hope seems to lie in the introduction of a parasite to check the advance of the aphis. The pest came originally from Europe, but it is not common, and an intensive search will have to be made in Central Europe to find its insect parasites. These insects will then be brought to England and bred up at the Farnham Royal laboratories. Nearly one million insect parasites have been bred and dispatched from time to time from Farnham Royal to all parts of the Empire. The wheat-stem sawfly, one of the Western farmers' major problems, is now being investigated. Officers of the Imperial Institute of Entomology have collected parasites in France and bred them up in England. Last season several large consignments of broken wheat straw, containing sawflies plus parasites, were packed in special boxes and shipped to Canada. These parasites have been released in the wheatfields, and up to date are doing well.

#### Blanching of a Bay Horse

In the *Field* for April 16, p. 582, Miss J. McAlpine gives an account of a bay horse the mane of which, black as usual in this colour, turned nearly white owing to a severe fright it received at six years of age when out at grass in a very long field. An aviator, in trying to land here, drove the horse the whole length of the field, and nearly alighted on it. No one saw the horse for three days afterwards, but it was then found to have lost the colour of its mane, as described,

while the tail had also become quite grey. A photograph of the animal, now nine years old, accompanies the note, and shows the pale mane very plainly, so that the effect of the shock seems to have been permanent. The writer of this note once casually saw in a London street a bay pony with a grey mane and also an angular grey patch let in, as it were, on the brown short hair of the neck, but put it down to a freak of variation. The horse is more liable to variation in pelage than any other domestic mammal, and another bay, an aged van-horse, also seen casually in London, was spotted with white over the brown parts as clearly as any deer, but with smaller, more angular spots.

#### Frequency of Insects in the Air

AMONG a recent series of "Why the Weather" articles by C. F. Talman, issued by Science Service, there is one article commenting on some experiments made in France by A. Bonnet to determine what that meteorologist called the 'entomological density' of the air, a few feet above the ground. This quantity, defined as the number of insects in a cubic metre, was obtained by means of a muslin net attached to the front of a motor car. The car was driven for a kilometre in unfrequented regions far from places where insects collect in exceptional numbers, and the insects in a 1000 cubic metre sample of air were collected and counted. The density was found generally to vary from one or two at sunrise to about seventy in the early afternoon, with a subsequent decline to one or two again at sunset. Those species normally found only very early and late tended to appear in the middle of the day when the air was nearly saturated. This is a line of research that might appeal to motoring meteorologists. It would be interesting to trace the effect of the insect density upon visibility, and see to what extent some of our midsummer hazes are due to large values of this quantity.

#### Orthographical Relief

A NEW method of showing surface relief on a topographical map is described by Prof. T. Kiturô in the *Geographical Journal* for March. The inventor claims this to be a natural, in contrast to a conventional, method, since it is based on the principle of shading, and gives the reader the appearance of the land rather than detached information of heights. The method makes use of what Prof. Kiturô calls the 'inclined contour'. This is defined as the projection upon a datum plane of the outline of the intersection of the ground surface with an inclined plane. By contrast, the ordinary contour, which is distinguished as the horizontal contour, is the projection upon a datum plane of the intersection line of the ground surface with a horizontal plane. The inclination of the inclined plane is assumed to be 45°. The effect of these inclined contours is to give a shaded map of relief features with a southern illumination on the specimen of a Japanese map which is reproduced. The thickness of the inclined contours is constant, and after experiment it was found most useful to have between thirty and seventy lines to the centimetre.

The method of drawing these contours from the ordinary contoured map is fully described. One obvious disadvantage is that they give a dark map, but this might be overcome by drawing the contours in grey or buff. The finished map certainly gives a striking picture of relief where the slopes are steep.

#### Sugar Cane Research

THE Report of the proceedings of the Imperial Sugar Cane Research Conference, held in London in July 1931, has recently been issued by H. M. Stationery Office (price 2s 6d net). The conference, to which reference has already been made in NATURE (July 25, p. 160) was convened by the Empire Marketing Board to discuss the future of scientific research in sugar cane production, but it was decided that the world economic position should be considered in drawing up a research programme. As a result, some seventy pages of the report give a review of the economic position of the industry, which contains many valuable facts and figures. The present organisation of research within the British Empire is considered in some detail in reference to the various cane sugar growing areas, after a brief general introduction by Dr P. S. Hudson that deals mainly with the genetical side of the problem. Dr. Hudson concludes that whilst some early advances have been made, and still may be expected, the full utilisation of scientific methods in breeding, which involves a cytological study of the genetical material, can alone lead to continued progress and development in this line of work, which is of so much importance in developing Empire resources. Dr. W. R. Thompson points out that, owing to the wide range of habitat in which sugar cane can be successfully grown, it suffers from an unusually large list of insect parasites. With some of these, such as the leaf frog hopper in Hawaii, a very great measure of success in combating them has been obtained by using the method of biological control. Dr. Thompson states that the method of biological control has this great advantage that, when it can be successfully applied, it provides what is practically permanent relief at a relatively small initial cost.

#### Evaluating Periodicities by Machinery

THE application of Fourier's harmonic analysis to weather phenomena has revealed many outstanding periodicities. To those who feel that the next step should be directed towards understanding the cause of these periodicities, rather than the evaluation of yet more, the invention of mechanical aids to 'periodicity hunting', such as Abbot's periodometer, will naturally make little appeal (Smithsonian Miscell. Coll., vol. 87, No. 4 (Pub. 3138)). "The Periodometer, an Instrument for Finding and Evaluating Periodicities in Long Series of Observations." By Dr. C. G. Abbot. The device is one for avoiding numerical computation in studies of this kind. It does not detect periodicities, that has to be done by inspection of the statistical material. This step involves a personal factor. Given any suspected periodicity, the machine shows to what extent this appears consistently throughout the material, and determines

the shape of the curve of variation of the element over this period. The reality of the periodicity is judged from the shape of this curve. Having decided that it is real, the operator is then able, with the aid of the machine, to eliminate this periodic variation, and so gets a residual curve that is scrutinised afresh for other periodicities. The curve of variation may depart widely from a simple sine curve, and this method of analysis therefore differs from the classical Fourier process, and on account of the presence of the personal factor will give different results when different workers use the same material. The ultimate test of merit is, of course, whether the method will lead to greater knowledge of underlying physical causes, and it remains to be seen whether this will be the case. The cost of production of the first periodometer was apparently a thousand dollars, the money being provided by the Research Corporation of New York.

#### Chemistry and Action of Drugs

In his Lane Lectures on pharmacology, Prof. W. Straub, of Munich, discusses certain problems of general interest in the chemistry, synthesis, and action of drugs (Stanford University Publications, University Series, Medical Sciences, vol. 3, No. 1, 1931, London: Humphrey Milford). Two are devoted to digitalis, the chemistry of the glucosides of the leaf and their physiological action being reviewed. Prof. Straub points out that the differences in action of the glucosides of the cardiac tonics, digitalis, strophanthus, and squill, can be explained to a great extent by a knowledge of the speed with which they are taken up by the tissues of the body as well as by the heart, and of the ease or difficulty with which they can be afterwards destroyed. The greater response of the pathological, as compared with the normal, heart to digitalis can be similarly explained, since the slowing of the circulation permits of a greater absorption of the drug by the tissues. These lectures were primarily addressed to pharmacologists. Three subjects were chosen as of interest to students and physicians, anaesthesia, the pharmacology of the heavy metals, and the camphor problem. In the latter lecture Prof. Straub discusses the attempts made to prepare a synthetic compound having similar stimulant effects to camphor on a failing heart and respiration without its disadvantage of slow absorption after injection. Cardiazole (pentamethylene tetrazole) appears to fulfil the requirements best at the present time; it is more soluble in water than in oil, so that it will be rapidly absorbed, but its oil insolubility will ensure that it exerts a stimulant rather than a narcotic action on the central nervous system. The sixth lecture, addressed to a scientific audience without medical interests, dealt with certain general problems of the use of intoxicating drugs.

#### Reconstruction of Tokyo and Yokohama

DURING the seven years that followed the great earthquake of Sept. 1, 1923, the rebuilding of Tokyo and Yokohama was practically completed, at a cost of nearly eighty-five million pounds. M. Jean Gracy has written a full account of the renovated cities, of



which a summary is given in the last number of the *Matériaux pour l'Étude des Calamités* (pp 156-165, 1931). The total area appropriated for new streets and parks is 914 acres in Tokyo and 89 acres in Yokohama, and of this, one-tenth was taken from the previous owners without compensation. In Tokyo, three classes of streets have been laid down. In those with much traffic, the total length is 73 miles; no street is less than 80 ft wide, and some for short distances are as much as 108 ft and 144 ft, and one even 252 ft wide. Those with a moderate amount of traffic have a total length of 86 miles and a width varying from 36 ft to 72 ft. Four hundred bridges have been restored so as to resist both fire and earthquakes. The value of open spaces was well shown in 1923. Accordingly, three large parks have been made with a total area of nearly 50 acres, and 51 small ones with an area of 37 acres, the latter being usually near primary schools, for which they serve as playgrounds.

#### Absorption Spectrophotometry

MESSRS Adam Hilger, Ltd, 98 King's Road, London, N W 1, have issued a bound book of eighty pages dealing with the theory and practice of absorption spectroscopy (price 5s net, postage 3d). It contains a brief theoretical introduction, then thirty-two pages of description of Hilger apparatus and description of technique, including work in the ultra-violet, visible, and infra-red regions, with a note on photoelectric methods, and the rest of the book deals with applications, particular attention being directed to biological aspects and analysis. This contains references to original literature. A companion volume, entitled "Recent Applications of Absorption Spectroscopy" (price, bound, 3s 6d, postage 2d), published by Messrs. Hilger, provides a very complete and carefully classified account of the literature from 1922 to 1931, with useful notes. The two publications form a handy yet compendious guide to the practice and literature of spectrophotometry in all parts of the optical spectrum, and may be recommended to all interested in this branch of science.

#### Health of the Navy in 1930

THE health of the Navy during 1930 appears to have been remarkably good, judging by the details contained in the "Statistical Report" for the year, recently issued by the Admiralty (London. H M Stationery Office 2s 6d net). The total number of cases of disease and injury in a force of 88,840 men was 38,031, a marked decrease on the previous year and in comparison with the five years' average. Venereal diseases head the list of admissions with 5154 cases, respiratory catarrhs (4378 cases) and tonsillitis (2429 cases) coming next, apart from local injuries and wounds, which numbered 7238 cases. There were only 36 cases of alcoholism, 11 cases of typhoid and paratyphoid fevers, and 5 cases of Mediterranean fever.

#### Announcements

THE Masters' Memorial Lectures of the Royal Horticultural Society will be delivered in the lecture

room of the Society's new hall in Greycoat Street, Westminster, on May 10 and 11, at 3 30 P.M., by Sir Frederick Keeble, on "Garden Fertility. its Origin and Maintenance"

THE Royal Society of Edinburgh announces that the Keith Prize for the period 1929-31 has been awarded by the Council to Dr A W Greenwood, lecturer in the Institute of Animal Genetics, University of Edinburgh, for papers on the biology of the fowl, and the Neill Prize for the period 1929-31 to Dr C H O'Donoghue, reader in zoology in the University of Edinburgh, for papers on the blood vascular system, and for earlier work on the morphology of the *corpus luteum*.

LIEUT -COL F C SHELMEKDINE, Director of Civil Aviation, opened an exhibition of aerial photographs by Aerofilms, Ltd, on Tuesday, May 3, at the Camera Club, 17 John Street, Adelphi, W C 2. The exhibition will remain open to the public until May 31 daily from noon until 6 P.M. Examples are shown of the application of aerial photography to archaeological and geological research, general survey work, town planning, and many other problems.

*Australian Science Abstracts*, a quarterly publication issued by the Australian National Research Council, Sydney, is a useful guide to investigations dealing with many aspects of Australian scientific activity—anthropology, zoology, botany, and physiology, veterinary science, agriculture, and economics, geology, geography, chemistry, and engineering. The subscription price is 4s a year, including postage.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.—An assistant physicist in the Radiological Department of the Cancer Hospital, Fulham Road.—The Secretary, Cancer Hospital (Free), Fulham Road, S W (May 12). A full-time teacher, mainly for science or mathematics in the Junior Technical School, Horwich, and for engineering subjects in the Technical College.—The Secretary, Railway Mechanics' Institute, Horwich (May 13). A pathologist for certain of the Liverpool Corporation Hospitals.—The Town Clerk, Municipal Offices, Liverpool (May 14). A director of education of the Polytechnic, Regent Street.—The Clerk to the Governors, The Polytechnic, 309 Regent Street, W 1 (May 21). A principal of the Cordwainers' Technical College.—The Clerk to the Board of Management, Cordwainers' Hall, 7 Cannon Street, E C 4 (May 24). An assistant keeper on the higher staff of the Victoria and Albert Museum.—The Director and Secretary, Victoria and Albert Museum, South Kensington, S W 7 (May 31). Assistant lecturers in, respectively, philosophy and physics at the University College of Swansea.—The Registrar, University College, Singleton Park, Swansea (June 4). A student probationer (zoologist or physiologist) at the Marine Biological Laboratory, Plymouth.—The Director, Marine Biological Laboratory, Plymouth (June 10). A borough electrical engineer to the Durban (South Africa) Corporation.—The Town Clerk's Office, Durban, Natal, South Africa (July 15).

## Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

### Action of the Alkaloids and Carbon Monoxide on the Enzymatic Activity of Plants

IN a series of investigations which I began during 1929<sup>1</sup> I was able to demonstrate, with the help of my collaborators, that the debatable question of the function of alkaloids in plants could be profitably examined by investigating the various enzymatic activities, beginning with those of germinating seeds.

The first case that I examined was that of barley in which exists, as is well known, an increasing activity of amylase with increase of germination. Beside, I noticed a net augmentation of activity due to the addition of dilute solutions of strychnine nitrate. In turn<sup>2</sup> the activities of lipase, amylase, protease, and oxidase were measured in castor oil seeds germinating in pure water and in strychnine nitrate solutions of different concentrations. In every case the addition of strychnine at the concentration optimum of 1 per thousand causes an increase of activity. It should be noted that this increase is not due to action of the alkaloid on the enzymes already formed, because the effect is not observed with the enzymatic extracts of seeds.

The amount of increase of the activity is different, the most sensible effects being in lipase and oxidase. The effect of alkaloids being consequently selective for different enzymatic activities explains, in my opinion, why they do not always help the growth of plants, in effect, they can determine a want of equilibrium in the various biochemical activities, which for full growth of the plant we suppose must be properly proportioned. Investigations showed that the *Ricinus* seedlings, that were followed for a month during their germination, showed constant improvement, by the addition of solutions of strychnine nitrate. The alkaloid contained in the bark of the *Ricinus* seeds, ricinine, has shown itself necessary for the germination, but strychnine can be substituted for it. Caffeine has also been found to be advantageous up to an advanced age, but this is an isolated fact, because this alkaloid is toxic for barley, flax, and other plants. From the observed facts, the opinion that alkaloids must be considered as hormones of the plants is strengthened.

My researches show that carbon monoxide itself alters in a sensible way the enzymatic activities of plants. This gas, also in small quantities, stops the assimilatory activity of green plants in light, but not the respiration (oxidase), so it was supposed that it also had selective action on the enzymatic secretions.<sup>3</sup> It was effectively shown that carbon monoxide depresses amylase activity of barley and of *Ricinus* powerfully, while in the same *Ricinus* it increases slightly the lipase activity. In consequence, the behaviour of the gas during the germination of seeds was to be expected to be irregular, thus it was found that while wheat is able to germinate in an atmosphere rich in carbon monoxide, the field cabbage and hemp only germinate with great difficulty, while flax and tomato do not germinate at all. Leguminous plants, such as lupin and pea, showed special behaviour: they are able to germinate in an atmosphere rich in carbon monoxide, and also if the operation is accomplished under a cover with seeds

made sterile a considerable absorption of nitrogen which causes much depression is observed.<sup>4</sup>

The determination of the contained combined nitrogen denoted an increase from 20 to 40 per cent in a few days. This fact combined with the selective action of carbon monoxide and of alkaloids on the enzymatic activity of germinating seeds makes one believe that the nitrogen assimilation in leguminous plants, as other authors have supposed, is due to the stimulating action of nitrogen bacteria, but not exclusively to these bacteria. The nitrogen assimilation is related to enzymatic activities which are latent in leguminous plants. In further confirmation of this are the new investigations that we are making now, from which it appears that the alkaloids also are able to promote nitrogen assimilation by lupins and peas.

The other effects, observed up to now in different seeds, in relation to different enzymatic activities, are summarised in the accompanying table.

| Seed           | Exciting Substance                | Percentage Variation of the Enzymatic Activity |             |         |          |
|----------------|-----------------------------------|------------------------------------------------|-------------|---------|----------|
|                |                                   | Lipase                                         | Per-oxidase | Amylase | Protease |
| <i>Ricinus</i> | Carbon monoxide (50 per cent air) | +5                                             |             | -70     |          |
| "              | Strych 1 $\frac{1}{1000}$ pH=4.6  | +20                                            | +150        | +4      | +10      |
| "              | Strych 1 $\frac{1}{1000}$ pH=6.8  | from +50 to +250                               |             |         |          |
| "              | Ricinine 1 $\frac{1}{1000}$       | +30                                            |             |         |          |
| Barley         | Caffeine 0.5 $\frac{1}{1000}$     |                                                |             | -20     |          |
| "              | Strych 0.5 $\frac{1}{1000}$       |                                                |             | +80     |          |
| "              | Carbon monoxide                   |                                                |             | -70     |          |

Investigations on these lines are being continued in this Institute, and will be extended to other kinds of plants and alkaloids.

MAURIZIO PADOA

R. Scuola Superiore di Chimica Industriale,  
Bologna, March 12

<sup>1</sup> M. Padoa, *Giorn. Chim. Ind. Appl.*, 11, 504, 1929; 12, 247, 495; 1930.

<sup>2</sup> M. Padoa e A. Spada, *Giorn. Biologia Appl. all'Ind. Chim.*, 1, Nos 1, 3, 5, 6, 1931.

<sup>3</sup> M. Padoa e Nerina Vita, *Ann. Chim. Appl.*, 19, No 4, 1929; *Biochem. Z.*, 244, Nos 4-6, 1932.

<sup>4</sup> Nerina Vita, *Biochem. Z.*, 245, Nos 1-3, 1932.

### Colour Response in a Leech

COLOUR change in response to environmental conditions has been described in the following groups: vertebrates, crustaceans, and certain molluscs. There are two types of mechanism by which rapid redistribution of the pigment in the skin is brought about. In molluscs, the pigment is contained in minute elastic bags, which can be expanded by means of a specially arranged musculature, and contract because of their own elasticity. In crustaceans and vertebrates, the pigment is present as granules inside stellate cells, and can migrate through the protoplasm, being either localised in the centre of the cell or distributed more or less evenly through its processes.

The common fresh-water leech *Glossosiphonia complanata* has conspicuous stellate cells in its skin, containing brown or black pigment. I have observed that the pigment in these cells undergoes changes in configuration, contracting together if the animal is kept in total darkness, and spreading out into the stellate shape if it is kept in light. They are therefore chromatophores of the vertebrate-crustacean type. Curiously enough, they are so few and so widely spaced that their activity has little or no effect on the general coloration of the leech.



The accompanying photographs (Fig. 1) were obtained as follows. A number of leeches were kept in darkness for several days, and then pairs were selected, the two members of each pair having chromatophores in the same state of expansion. One member of each pair was kept in daylight for a day, while the other was put back into darkness. They were then fixed, mounted whole in balsam, and photographed. The upper photograph shows a group of chromatophores from the illuminated member of such a pair, and the

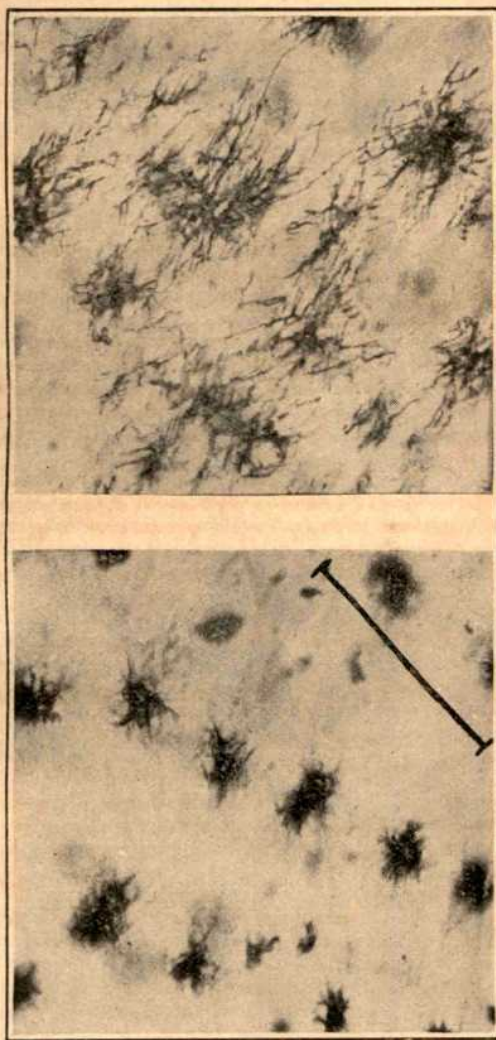


FIG. 1.

lower is a group from its fellow kept in darkness. The scale line on the lower picture represents 0.3 mm.

Hogben and Slome<sup>1</sup> have shown that there are two distinct modes of response to light in vertebrate chromatophores:

(1) 'Primary Reactivity': expansion in light, and contraction in darkness. This response is seen in blinded animals, and is probably a direct effect of the light on the chromatophores themselves.

(2) 'Secondary Reactivity': expansion when the animal is illuminated on a dark background, and contraction when it is illuminated on a pale background. This is a complex response, involving the eyes and a co-ordinating mechanism, and is superposed on the first.

Preliminary experiments have revealed no response

to background in *Glossosiphonia*, which apparently presents the primary mode of response alone and uncomplicated by the secondary. G. H. Parker<sup>2</sup> has recently pointed out that in vertebrates, crustaceans, and cephalopods the visual organs are highly developed, and suggests that colour change has only evolved in groups in which the eye is capable of distinguishing the details of the luminous environment. It is therefore interesting to note that a chromatophoral mechanism exists in an animal with eyes of extremely simple construction, and that it is of the mode which, in vertebrates, does not depend upon the visual organs. Prof. Parker's generalisation remains valid if it is restricted to secondary reactivity, that is, to colour change in response to background.

The physiology of the response and its possible occurrence in other leeches are being investigated.

G. P. WELLS.

Department of Zoology,  
University College, London,  
April 2.

<sup>1</sup> Hogben and Slome, *Proc. Roy. Soc., B*, **108**, 10; 1931.

<sup>2</sup> G. H. Parker, *Proc. Nat. Acad. Sci.*, **17**, 594; 1931.

#### Is Preformed Cystine Essential to Sheep for Wool Production?

IN a recent paper<sup>1</sup> attention has again been directed to the fact that the proteins of pasture grass contain only exceedingly small quantities of the sulphur-containing amino-acid cystine.<sup>2</sup> As Evans points out, sheep's wool is relatively rich in sulphur, and this, it has been shown, is almost exclusively present as cystine<sup>3</sup> (13 per cent by weight of cystine may be taken as an average figure for wool keratin).

Since cystine has always been regarded as an 'essential' amino-acid which the animal body is unable to synthesise, it becomes of interest to calculate the amount of food necessary to produce a year's growth of wool. A 12 lb. fleece may be assumed to yield 6 lb. of clean wool, containing 0.78 lb. of cystine. Putting the cystine content of pasture herbage, which comprises the main part of a sheep's daily ration in many parts of the world, at 0.01 per cent on weight of dry matter, and, for the sake of argument, assuming that none of this cystine is katabolised and excreted, it follows that an animal must eat 21.4 lb. of dry grass per day, or about 60 lb. of fresh pasture—an impossible amount, since a normal, fully grown sheep under optimal conditions will consume only about 4 lb. per day.

The wool research workers in Australia under the late Prof. Brailsford Robertson assumed that the quantity of cystine available in the diet of sheep must be a factor limiting the quantity of wool they can produce.<sup>4</sup> The sulphur content of wool is not fixed, however, but variable,<sup>5, 6</sup> and it appears that the sulphur content (cystine content) of wool grown during periods of adequate nutrition, for example, after rains when the pasture is lush, is higher than that grown during periods of scarcity.<sup>6</sup>

In Bonsma's experiments, controlled feeding on maize meal (poor in cystine) over a whole year failed, however, to bring about either marked decrease in fleece weight or in sulphur content of the wool grown. It would appear that more cystine is used in producing wool than can be accounted for in the food eaten.

Evans concludes, as have others, that there must be present in the diet some substance closely related to cystine from which the latter can be synthesised. Neither cysteic acid,<sup>7</sup> taurine,<sup>8, 9</sup> sulphates, elementary sulphur,<sup>10</sup> dithio-glycollic acid, or dithio-dipropionic acid, in spite of their close chemical resemblance to cystine,<sup>11</sup> nor any other compound (with the exception



of cystine peptides) has ever been reported in the literature as capable of replacing cystine in the diet.

It would appear, however, that no strict feeding experiment, keeping a cystine and sulphur balance-sheet, has ever been performed upon a sheep—the assumption that cystine cannot be synthesised being borrowed from experience with laboratory animals.<sup>12, 13, 14</sup> It is the purpose of this note to point out that the two cases are entirely dissimilar, and to suggest a very plausible manner in which the cystine requirements of sheep can be met whilst on a cystine-deficient diet which contains, however, sufficient other sulphur-containing compounds.

The mouse, rat, and guinea-pig are omnivora, characterised by quick metabolism, whilst the sheep is a herbivorous animal, in the gut of which bacterial activity plays a very important rôle.

It is customary in nutritional work upon sheep to allow 6-8 days for the complete passage of the ingesta through the alimentary canal. The intestinal flora and fauna (bacteria, yeasts, etc.) are almost certainly able to synthesise cystine from inorganic sulphur and it is conceivable that the population of the sheep's intestine, by continual increase, is transforming sulphates into cystine, built into their own protoplasm, with a high grade of efficiency. As bacteria die, their cell protoplasm autolyses, again setting free the sulphur, now in the form of cystine, which is readily available to the sheep.

That the metabolism of an ingested product does actually follow a different course in carnivora and in herbivora has been demonstrated in the case of taurine by the experiments of Schmidt and Clark<sup>15</sup> and of Salkowski.<sup>16</sup> It is computed that in man about 8 gm. of bacteria are excreted in the faeces daily, and this number will almost certainly be much higher in the case of the sheep, so that from the quantitative point of view the above argument is satisfactory. Some experiments are being planned at the Onderstepoort Laboratory to put our hypothesis to the test.

It seems to us of the utmost importance that this question should be thoroughly investigated, and the availability or otherwise of simple sulphur compounds for wool production by the sheep settled beyond all doubt. Otherwise, there is a danger that whole schemata of nutritional research and of advice to the pastoralists in two continents may rest upon no surer foundation than an unjustifiable assumption.

CLAUDE RIMINGTON.  
J. G. BEKKER.

Onderstepoort Veterinary Research Laboratory,  
Pretoria, South Africa, Feb. 1.

<sup>1</sup> Evans, *J. Agric. Sci.*, **21**, 806; 1931.

<sup>2</sup> Aitken, *Biochem. J.*, **24**, 250; 1930.

<sup>3</sup> Rimington, *Biochem. J.*, **23**, 41; 1929.

<sup>4</sup> Marston and Brailsford Robertson, Commonwealth of Australia Coun. Sci. and Ind. Res., *Bulletin* **39**, 1928.

<sup>5</sup> Barritt and King, *J. Text. Inst.*, **17**, T. 386; 1926.

<sup>6</sup> Bonsma, *J. Text. Inst.*, **22**, T. 305; 1931.

<sup>7</sup> Lewis and Lewis, *Proc. Soc. Exp. Biol. Med.*, **23**, 359; 1926. *J. Biol. Chem.*, **69**, 589; 1926.

<sup>8</sup> Rose and Huddleston, *J. Biol. Chem.*, **69**, 599; 1926.

<sup>9</sup> Beard, *Amer. J. Physiol.*, **75**, 658; 1925-26.

<sup>10</sup> Daniels and Rich, *J. Biol. Chem.*, **36**, 27; 1918.

<sup>11</sup> Westerman and Rose, *J. Biol. Chem.*, **75**, 533; 1927.

<sup>12</sup> Osborne and Mendel, *J. Biol. Chem.*, **20**, 351; 1915.

<sup>13</sup> Jones and Finks, *J. Biol. Chem.*, **41**, 379; 1920.

<sup>14</sup> Gelling, *J. Biol. Chem.*, **31**, 173; 1917.

<sup>15</sup> Schmidt and Clark, *J. Biol. Chem.*, **53**, 193; 1922.

<sup>16</sup> Salkowski, *Virchows Archiv*, **58**, 460; 1877.

### Inheritance of Milking Capacity

I SUBMIT that on the evidence available Mr. Madsen<sup>1</sup> was justified in reaching the tentative conclusion, that some of the genetic factors governing milking capacity are transmitted in a sex-linked manner, and that the points mentioned by Mr. Edwards<sup>2</sup> in his letter are based upon a misapprehension of the subject. Mr.

Edwards states two objections, but if his first one be analysed it will be seen to contain three different points, so that all Mr. Edwards's objections to the conclusion reached by Mr. Madsen may be summarised as follows:

1. That the sires are selected by genotype, rather than phenotype.
2. That the record of a single cow is insufficient in foretelling the production of her progeny.
3. "... it is doubtful if one should expect to find a significant difference in the correlations of two such records diluted through three generations."
4. That the difference between the two correlation coefficients is not significant, and that such a difference would be likely to occur by chance once in ten times.

The logic on which the first objection is based is not clear. How does the method employed in the selection of the sires affect the grandams? Would Mr. Edwards argue that those cows which are mated to bulls selected by genotype are of a different order from cows mated to bulls selected on phenotype? Or would he argue that since the sires of the bulls involved are selected on their genotypes, therefore their dams are of a different order from the maternal grandams of the bulls in question? In any event, when the full paper is published, Mr. Madsen will show that the majority of the sires involved have not been selected on genotype, but on appearance plus pedigree.

As to the second objection, Mr. Edwards should know that dairy cattle are extremely heterozygous for the factors governing the transmission of milking capacity; and further, that it is the exception for the genotype of a cow to be assessed in respect of milk yield, because her offspring are few and seldom all sired by the same bull. It is not to be expected that the records of a single cow will be of great value in foretelling the production of her progeny by another bull. I would point out that a statistical study is based on the average of a large number.

Mr. Madsen in his letter was particularly careful to stress the fact that the *genotypes* of the male, but the *phenotypes* of the female, ancestors were being compared to the genotypes of their sons and grandsons, and that consequently correlations to the female ancestry were in a category by themselves. Both of Mr. Edwards's objections seem to be based on a misunderstanding of Mr. Madsen's statements.

The third objection is based on the speculation that, with the material used by Mr. Madsen, no correlation to the grandams was to be expected. Incidentally, this was also my own expectation. But Mr. Madsen has shown that this is not so. Despite the inevitable drawbacks of his method, he has given good reason to believe that there is a small but significant correlation to the maternal grandam, while the slight positive correlation to the paternal grandam is insignificant. Mr. Edwards is scarcely justified in upholding speculation against ascertained fact.

The last objection refers to the value of the standard error. If the study were to be contained within reasonable limits, an error of such value was unavoidable. Actually more than 100,000 lactations had been analysed and classified. Mr. Madsen's conclusions are based not merely on his own work, but also on the material contained in the paper by myself, Scott and Fowler,<sup>3</sup> which he quotes, and, by implication, on the work of Gowen, to which reference is made in our paper. Mr. Madsen was also acquainted with other papers dealing with this subject, including the most recent one from this Institute,<sup>4</sup> which presents a case for the possibility that certain of the genetic factors controlling milk production are inherited in a sex-

linked manner. Any one of these several investigations alone might be insufficient for drawing such a deduction, but when what Mr. Edwards calls one chance in ten recurs repeatedly, it is surely not illogical to presume that it has some significance, and to try to interpret the facts. Of all possible explanations, sex-linkage is not only the simplest, but also the most reasonable.

I should like also to correct an error on the part of Mr. Edwards. If he will re-calculate the figures carefully, remembering that he is dealing with a *standard* error of  $\pm 0.03$ , he will find that the results would be likely to occur by chance, not once in ten times, as he states, but once in twenty. I leave it to others to determine whether this difference is significant.

Finally, I may take this opportunity of congratulating Mr. Madsen on his study, which is in some respects the most comprehensive of this nature that has as yet been made. His material is unique and his results give considerable food for thought. It is to be regretted that funds for such research, both in Britain and in Denmark, have been recently curtailed, so that the publication of the full paper has been considerably delayed.

A. D. BUCHANAN SMITH

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April 16

<sup>1</sup> NATURE, Jan. 30, p. 165.

<sup>2</sup> NATURE, March 19, p. 437.

<sup>3</sup> *J. Dairy Research*, 1, pp. 174-179, 1930.

<sup>4</sup> Smith, A. D., Buchanan, and Robison, O. J., "The Inheritance of Milk Yield", Conference Papers, International Dairy Congress, Copenhagen, 1st Section, pp. 127-140, 1931.

#### Vocal Powers and Eyes of Kangaroos

MR. FINLAYSON<sup>1</sup> quite rightly corrects the statement that kangaroos are never known to utter any sound normally. I have in Melbourne, four miles from the Melbourne Post Office, at my home, two large grey kangaroos and eight wallabies. I have kept such animals for years, by reason of an investigation undertaken long since into the refractive condition of the eyes of the monotremes and marsupials and of mammalia generally.

Of the three sounds Mr. Finlayson refers to, I have heard two frequently. These ten animals are fed in the morning, and when they are hungry they have minor differences amongst themselves, and the kangaroos frequently make a sort of grunt or growl if they think that their food is being interfered with. The bark or cough is quite distinct. It may be a warning signal to kangaroos, but it is certainly a danger signal as regards human beings. Whether from gout or old age or something of the sort, the old male kangaroo occasionally becomes disagreeable, and the bark or cough, or what appears to be a bark or cough, is a warning to a human being—a warning which, if he is wise, he will heed—to keep away. The greatest danger comes from tame kangaroos, because they have no fear of man. I bred a very fine specimen of *Macropus Giganteus*, which later on became so dangerous, as we gathered from the continual barking, that I had to have him transferred to the Zoo. I have never known a female kangaroo to show any desire to attack, but on one occasion when some children were petting a baby kangaroo, just out of the pouch, the mother gave a soft growl, or what sounded like it.

Whilst writing, I may direct attention to the fact that I have not been able to obtain a good estimate of the refractive character or of the accommodation of the eyes of kangaroos or wallabies. In the case of some of the monotremes and the smaller marsupials the work has been done, and a note appears in the

*Medical Journal of Australia* for Feb. 6, 1932, summarising the result.

Subject to an investigation of the kangaroos, which is very difficult owing to their size and the difficulty of handling them, the result is that the eyes of the animals referred to are imperfect as optical instruments, and there is no evidence that they accommodate at all. Throughout the mammals, until the primates are reached, accommodation is rudimentary or absent, and the ciliary muscle is variable or rudimentary in amount. This capricious development, or want of development, of accommodation in these creatures opens up the fundamental riddle from the point of view of evolution. Why these animals should have rudimentary accommodation and a variable ciliary muscle, which can be of no real service—especially in some cases owing to the gross error of refraction in their eyes—so far appears to be an insolvable puzzle.

Those who have read Prof. W. A. Osborne's recent article on accommodation in the animal kingdom and Prof. Wood Jones's Bancroft lecture, both published in the *Medical Journal of Australia*, 1931, will realise the extraordinary complexity of the problem which accommodation in animals presents. I hope it will be possible to investigate accommodation in kangaroos, but this involves the capture of the animal, the maintenance of his life, and the frequent use of anaesthetics.

JAMES W. BARRETT

103-105 Collins Street,  
Melbourne, C 1,  
March 1

<sup>1</sup> NATURE, Jan. 23, p. 131.

#### Types of Iridescent Clouds

THE remarkable clouds at high altitude which have been the subject of two interesting articles by Prof. Carl Størmer<sup>1</sup> and Prof. S. Chapman<sup>2</sup> in *NATURE* are referred to as iridescent or mother-of-pearl clouds. In order to prevent misunderstanding, I should like to point out that the high clouds in question should not be confused with the much more common 'iridescent clouds' which are described in most textbooks of meteorology.<sup>3</sup> The latter are cirro-stratus or cirro-cumulus clouds and are certainly well within the troposphere, at a height of approximately 10,000 metres, while the clouds described by Størmer are two or three times as high and are well within the stratosphere.

While the high clouds in the stratosphere can be confused with much lower clouds on account of the use of the adjective 'iridescent', they can also be confused with another type of cloud because of the use of the adjective 'high'. Occasionally, generally after violent volcanic eruptions, bright clouds can be seen long after sunset, showing that they are at a great altitude. Prof. O. Jesse has determined the height of these 'luminous night clouds' to be between 70 and 80 kilometres, and they are, therefore, much higher than the high iridescent clouds described by Størmer and Chapman, both of whom are careful to warn their readers against confusing the two types of high cloud.

There are then three types of clouds which have to be carefully distinguished: (1) iridescent clouds in the troposphere at 10 kilometres, (2) high iridescent clouds in the stratosphere at 20-30 kilometres, and (3) high luminous night clouds at 70-80 kilometres. The physical composition of these three types of clouds is an interesting problem. In order to explain the brilliant colours on the iridescent clouds of the troposphere, it is necessary to assume that in spite of the low temperature at which they occur (about  $-40^{\circ}\text{C}$ ), these clouds are composed of super-cooled water.

drops, or at least of small spheres, and not of crystals<sup>4</sup>. The same reasoning would indicate that the iridescent clouds of the stratosphere are also composed of drops, but there is so little water vapour in the stratosphere that it is difficult to see how clouds of the density described by Størmer can be formed.

The high luminous night clouds are supposed to derive their water from the volcanic eruptions with which they appear to be associated—they were particularly bright from 1883 to 1889 after the Krakatoa eruption—but the close association of the iridescent stratosphere clouds with a particular type of weather appears to make this explanation unsuitable for them.

It is quite clear that there is still a great deal to learn about the physical state of the upper atmosphere.

G. C. SIMPSON.

Meteorological Office, London,  
April 19

<sup>1</sup> NATURE, Feb 16, 1929, p. 260

<sup>2</sup> NATURE, April 2, 1932, p. 497

<sup>3</sup> See "Meteorologische Optik", by Pertner-Ebner, second edition, p. 460

<sup>4</sup> Simpson, *Quar. J. Roy. Met. Soc.*, 38, 291, 1912

IN NATURE of April 2, Prof Chapman has an interesting article on the iridescent (mother-of-pearl) clouds observed by Prof Størmer of Oslo. These clouds, which are unmistakable in appearance, are reported to have been at the great height of 26 to 30 km. I once discussed these clouds with the late Prof Mohn, but there was then no suggestion that they floated so high. Their appearance at the altitude now recorded opens up some interesting problems.

The clouds are to be seen from time to time at sea. It was my custom to call them 'fish-scale colour clouds' and to associate them with bad weather.

The reports of luminous 'night clouds' have always puzzled me, and although I spent a great deal of time in the open air, I have never seen them, nor have I ever met any seaman who has. Is it possible, however, that there may be some connexion between this great altitude and luminosity?

DAVID WILSON-BARKER

Royal United Service  
Institution, S.W.1

#### Hexuronic Acid as the Antiscorbutic Factor

WE have reported in a previous note,<sup>1</sup> that with a daily dosage of 1 mgm hexuronic acid guinea-pigs were kept free from symptoms of scurvy for fifty-five days. This experiment was continued to the ninetyeth day. During this time all animals receiving hexuronic acid showed normal growth. On the ninetyeth day all animals were chloroformed, and on autopsy were found entirely free from scurvy. The animals receiving 1 c.c. of lemon juice showed mild scurvy. The experiment was completed with all the necessary controls.

Since the hexuronic acid used was prepared from animal sources (adrenal glands), no objection can arise that the observed antiscorbutic activity was due to a contamination by a more potent antiscorbutic substance. The daily dose of hexuronic acid employed was of the same magnitude as the hexuronic acid content of the protective dose of lemon juice (15 c.c.). It is generally accepted that animals surviving ninety days with no symptoms of scurvy on autopsy and showing normal growth could be kept indefinitely free from scurvy under identical conditions. This allows us to conclude that vitamin C is a single substance and identical with hexuronic acid.

Simultaneously with our previous note, C. G. King and W. A. Waugh<sup>2</sup> reported that they have obtained, from lemon juice, crystals which showed antiscorbutic

activity and were apparently similar in chemical and physical properties to hexuronic acid. The duration of the test period was not stated, and apparently no chemical analysis was made. Until this is done, the nature of their product remains in doubt.

This research was sponsored by the Ella Sachs Plotz Foundation.

J. L. SVIRBELY\*

A. SZENT-GYORGYI

Institute of Medical Chemistry,  
University Szeged, Hungary, April 22

\* Holder of an American-Hungarian Exchange Fellowship, 1931-32, from the Institute of International Education, New York

<sup>1</sup> NATURE, April 16, p. 576

<sup>2</sup> Science, vol. 75, No. 1944, April 1, 1932

EVER since Prof A. Szent-Gyorgyi suggested the possible identity of hexuronic acid<sup>1</sup> with the 'reducing principle' present in all active antiscorbutic solutions, I have been experimenting at various periods in this connexion. These experiments led me to the conclusion that the likelihood of 'hexuronic acid' being identical with the antiscorbutic factor was small, but I much regret that owing to illness I am at the moment precluded from supplying from my experimental notes the relevant data which seem to me to justify this provisional conclusion. Moreover, in view of J. L. Svirbely and Prof A. Szent-Gyorgyi's claims referred to in NATURE of April 16, my previous experimental work on the subject will have to be further amplified, and therefore I cannot now enter into a detailed discussion of the matter. It is my intention, however, to make in this note only one or two comments on Svirbely and Szent-Gyorgyi's results.

According to Svirbely and Szent-Gyorgyi, 1 milligram of hexuronic acid was found to offer a marked protection against scurvy in guinea-pigs, and they justly assert that the activity of this compound is most probably higher, but that, owing to its long exposure to air, a loss of the vitamin has occurred and consequently the minimum dose would be lower than 1 mgm. They further state that 15 c.c. of lemon juice, the minimum protective dose for guinea-pigs against scurvy, is equivalent to 0.5 mgm of hexuronic acid, thus implying that the minimum dose of the antiscorbutic factor is about 0.5 mgm of hexuronic acid. In this connexion it must be pointed out that such minimum doses have been obtained by other workers and myself with fractions from lemon juice which were evidently grossly contaminated. This fact militates rather against the contention that hexuronic acid and the antiscorbutic factor are identical. The interesting point that emerges, in my opinion, from Svirbely and Szent-Gyorgyi's data is that it is possible to prepare active fractions of the antiscorbutic factor from a definite animal tissue.

S. S. ZILVA

Division of Nutrition,  
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<sup>1</sup> A. Szent-Gyorgyi, *Biochem. J.*, 22, 1387, 1928

#### Occurrence of 'Cleistogenes' in certain Grasses

BEDDOWS<sup>1</sup> has raised some interesting points regarding *Triodia decumbens*, particularly as regards the occurrence of 'cleistogenes' at the base of the fertile tillers in the cleistogamous form. Subsequent investigation of their structure has shown that these 'cleistogenes' may contain as many as three florets. Structures are present within their enveloping prophyll which possibly represent empty glumes, these, however, are by no means consistent either as to form or presence. The fertile florets, on the other hand, have well-developed flowering glume and palea. The three



minute bi-sporangiate anthers are intrastigmatic 'Cleistogenes' may ripen as many as two healthy caryopses, which have been found germinating *in situ*.

It is interesting to note that these 'cleistogenes' are apparently somewhat similar to the 'axillary spikelets' described by Weatherwax<sup>2</sup> for *Danthonia sericea*. 'Cleistogenes' have also been found in herbarium material of *Danthonia calycina* and *D. brevibracteata* very kindly supplied by Prof. Friedrich Vierhapper of Vienna.

I have found the rare open flowering or chasmogamous type of *T. decumbens* in Wales. This also produces 'cleistogenes'. Examination of the aerial inflorescences of this form shows a gradation between the characters usually associated with chasmogamy and those usually associated with cleistogamy. Weatherwax<sup>2</sup> describes a rather similar phenomenon in *Danthonia sericea*. ANNIE A. POULTER

Agricultural Botany Department,  
University College of Wales,  
Aberystwyth, March 31

<sup>1</sup> Beddows, A. R., "*Triodia decumbens* Beauv. (*Sieglingia decumbens*, Bernh.)", *Ann. Bot.*, 15, 1931.

<sup>2</sup> Weatherwax, P., "Cleistogamy in Two Species of *Danthonia*", *Bot. Gaz.*, 85, 1928.

### Bacterial Disintegration of the Wool Fibre

WITH reference to the note by R. Waters on the retting of wool,<sup>1</sup> workers in the field of wool research have long been acquainted with the bacterial disintegration of the wool fibre, as mentioned by him.

The phenomenon, as produced by micro-organisms, was described by Schimke in 1892, and, in 1898, Lobner associated such a condition with the activities of bacteria. So far back as 1866, however, Nathusius-Konigsborn directed attention to the spindle-shaped nature of the individual cortical cells. In 1902, Kalmann published illustrations of wool fibres which he had retted by macerating cloth with a pure culture of a spore-forming bacillus.

Confirmatory evidence has since been brought forward by MacInnes (1923), Hirst (1923), Trotman and Sutton (1924), Burgess (1924), Bartsch (1931), and others, most of whom have associated the retting process chiefly, but not exclusively, with members of the aerobic group of the Bacillaceae (Bergey).

As Mr. Waters suggests, the process, or perhaps the enzyme-containing extract, may be used to facilitate the study of the cellular structure of wool. Moreover, provided the cells themselves are not attacked, such a study may *prima facie* help to elucidate the nature of the different constituents of the fibre.

R. BURGESS

Microbiological Department,  
Wool Industries Research Association,  
Leeds, April 1, 1932

<sup>1</sup> NATURE, March 26, p. 467.

### Biological Effect of Associated Water Molecules

IN a recent book,<sup>1</sup> one of us (H. T. B.) has pointed out that water deprived of trihydrol would be quite useless to living organisms. This suggestion has been supported by experimental results,<sup>2</sup> which demonstrate that water rich in trihydrol obtained from melted ice will sustain filaments of the alga *Spirogyra* in a normal condition for several days, in contrast to filaments maintained under the same external conditions in water from the same source containing a lower proportion of polymerised molecules, in this dihydrol water the protoplasts soon shrink and the filaments become quite limp, due to loss of turgor.

Since the publication of the first report,<sup>2</sup> which described the macroscopical appearance of masses of

*Spirogyra* in the solutions, cytological observations have been made, with the help of Prof. F. E. Lloyd, showing that the water from recently condensed steam, containing less of the active polymer trihydrol, causes the *Spirogyra* filaments to assume a colourless mass which occupies a more compact volume than the same number of filaments in trihydrol water, which maintains the rigidity and turgor of the cells, and in this way the trihydrol filaments occupy a greater volume in the solutions. The collapsed protoplasts in water poor in trihydrol resemble plasmolysis forms with the chloroplasts badly twisted. Similar experiments are now being performed on *Euglena* and *Amoeba*.

HOWARD T. BARNES  
T. CUNLIFFE BARNES

McGill University, Montreal

<sup>1</sup> Barnes, Howard T., "Ice Engineering" Renouf Pub. Co., Montreal, 1928.

<sup>2</sup> Barnes, T. Cunliffe, *Proc. U.S. Nat. Acad.*, 18, 136, 1932.

### Absolute Energies of the Lines in $\beta$ -Ray Spectra

I HAVE been engaged for some time in investigating the  $\beta$ -ray spectra of thorium-B and the thorium-C bodies, and my measurements suggest that the published values of the energies of the groups may not be so accurately known as is generally supposed. This is a point of considerable importance, since it is now realised that there is a close connexion between the frequencies of the  $\gamma$ -rays which are deduced from  $\beta$ -ray spectra and the energies of the different groups of  $\alpha$ -particles emitted in the actual or neighbouring disintegrations. In investigating this connexion, it is necessary to compare the energies of  $\gamma$ -rays and  $\alpha$ -particles, and since there is no direct method of comparison, it is essential to know the absolute energies of both.

The published values for the energies of the lines in the  $\beta$ -ray spectra of the thorium bodies are nearly all based on a determination of Black's, but this in its turn was based on some experiments I made on the radium-B spectrum nine years ago. So far as my present experiments go, I think it is possible that many of the published values of the energies of the lines in the thorium (B + C) spectrum may be a half per cent or more too high, and quite likely also the values in the radium (B + C) spectrum. I am publishing shortly an account of my measurements, when this point will be fully discussed.

The object of this letter is, first, to direct attention to the need for some other independent measurement of the absolute energies, and, secondly, to prevent the too drastic use of the existing values either in support or criticism of any theory until this matter has been definitely settled.

C. D. ELLIS

Cavendish Laboratory,  
Cambridge, April 25

### Passage of Neutrons through Matter. a Correction

IN the note on the above subject published in NATURE of March 26, p. 469, the quantity  $k$  occurring in the formula for the loss of energy per centimetre path of a neutron due to electron collisions, is defined incorrectly as  $2\pi Mv/h$  where  $M$  is the mass of the neutron. This mass  $M$  is not the mass of the neutron, but the reduced mass of the electron and neutron or, effectively, the mass  $m$  of the electron. With this alteration it is believed that the formula is correct.

The field used in the calculation was  $\frac{e^2}{r} e^{-\lambda r}$ , not  $e^2 e^{-\lambda r}$  as there stated, which is of course dimensionally wrong.

H. S. W. MASSEY

Cavendish Laboratory,  
Cambridge, April 22

## Research Items

**Jewish Folklore in Palestine**—Miscellaneous notes on the folklore of the Jews in Palestine recorded by the late Mrs H Spoer (A Goodrich-Freer) and published in *Folklore*, vol 42, pt 1, include references to beliefs connected with sin, disease, and the powers of evil. Many of the Jews of Jerusalem travel down to Jaffa at the coming of the New Year in order to be able to shake their skirts into the waters of the little stream of el-Auja, praying and confessing their sins. It is necessary that there should be fish in the water, in order that they may devour the sins as they are shaken out. A variant of former days, possibly owing to the fact that there was then no railway, was to plant palm-leaf baskets with beans, one for each adult in the family. On the eve of New Year, each would swing the basket over his head, saying, "This basket instead of me", and then drop it in the water. At the present time, the father of the family has to lay his hand on a white cock, confessing his own sins and those of his family, unless they are old enough to perform the ceremony for themselves. During the cholera scare of 1909-10, recently immigrated Russian Jews, who cared nothing for local tradition, averted the danger in their own way by assembling in their own burial-ground on the Mount of Olives and making merry for a day and a night, even celebrating a mock-marriage, to the consternation of the orthodox. In this they were following Russian custom. Russian peasants distract the attention of the spirits of evil by celebrating the marriage of deformed or orphaned persons over the grave of someone who has died of cholera, thus diverting the danger in a direction in which it can do no harm.

**Society Islands' Canoes**—Dr E S Craighill Handy, in the course of a study of houses, canoes, and fishing in the Society Islands (*Bull* 90, Bernice P Bishop Museum, Honolulu), distinguishes three types of craft which have been described indiscriminately as canoes—dug-outs, built-up canoes with round bottom, and composite vessels with sharp keel. All these types depended on the outrigger for stability unless they were double. The dug-out, made for fishing in or near the reefs, sometimes had one or more strips fastened to the upper margin of the hull, thus forming a gunwale, which, giving more freeboard, enabled the canoe-polers to stand on the sides as they propelled the craft. The old built-up canoe consisted of a hollow log, or, in the larger vessels, of several logs fastened together. To these were added side-boards and bow and stern pieces. Their depth seldom exceeded 3 ft and their beam 21 inches. The after-part was generally one-third wider than the fore-part. The bow-piece had fastened to it a board projecting out for four or five feet parallel to the surface of the water. The modern sailing boats of the Leeward Islands are distinctly built-up boats, but they differ from the old model in the shape of the hull, which has a round instead of a V-shaped bottom and perpendicular sides. Both types of craft were made into the great pontoon or double canoes, two being lashed about 4 ft apart by spars and the interval bridged with poles to form a rough deck, sometimes surmounted by a thatched hut. The builders were a guild with rites and places of worship. Men and work were taboo while the canoe was being made, and on its completion a man was sacrificed and eaten by the priest of the chief's temple.

**Twins Reared Apart**—Another pair of identical twins reared apart has been studied by Prof H H Newman (*J Heredity*, vol 23, No 1). These girls,

now twenty-nine years of age, were separated at five months, but both were brought up in the State of Ohio, less than 100 miles apart. Mary, however, has resided in a small town from the age of six years, while Mabel has lived on a farm and engaged in farm work. Mary attended high school, then acted as clerk in a store, and afterwards gave pianoforte lessons. This occupational difference has made Mabel 28 pounds heavier, 1½ in taller, with greater muscular and bone development, although the extreme similarity in finger and sole patterns, eye and hair colour, and features prove them to be identical twins. Several series of psychological and intelligence tests show, however, striking differences in mentality and temperament. Mary ranks much higher in the intelligence tests, which throws some doubt on them as tests of innate ability. This pair of separated identical twins thus differ from each other physically, intellectually, and temperamentally. Of the four similar pairs previously studied, two differed intellectually but not temperamentally, while the other two were intellectually similar but very different temperamentally. In two cases there was also marked physical difference. Averaging these results and comparing them with 50 pairs of identical twins reared together, the difference in intelligence quotient (I Q) of separated identical twins is more than three times as great as that of those reared together. Another conclusion reached is that fraternal twins reared together are, on the average, one and a half times more similar in mental rating than are identical twins reared apart. Dr Newman concludes, nevertheless, that heredity is probably more potent than environment in determining mental status. The study of further pairs of separated twins should throw further light on this problem.

**Further Spread of the Land-Snail *Achatina fulca***—This large East African snail, three inches long, promises to become a menace throughout the tropical and sub-tropical world, half of which it already infests. Y H C Jarrett has prepared an account of its latest naturalisation, in Amoy, a centre from which it may well become a serious pest of Chinese agriculture (*Hong Kong Nat*, vol 2, p 262, 1931). The snail was transported from East Africa to Mauritius nearly a century ago, thirty years later it was carried thence to Calcutta, and in 1910 it had become common in northern Bengal. About 1900 it obtained a footing in Ceylon, and within little more than ten years had become a disgusting pest. From Ceylon or India to Malaya and to Singapore and so to China mark the stages of a progress which is certainly not at an end. The snail is voracious and prolific, it lays about a hundred eggs in its first year, two to three hundred at the end of the second year, and close on a thousand in all. In 1928 it was introduced to Sarawak from Singapore as food for poultry, and by 1930 had become so great a pest that in 1931 a small reward was offered for its destruction—between Oct 1 and Oct 15, 1931, approximately half a million snails and twenty million eggs were destroyed. Hand-picking, dumping in the ocean, burying the animals in sacks deep in the ground have all been tried, without much effect, as methods of control. The last hope appears to be that the snail may find a favoured place in the dietary of the Chinese populace.

**Spotted Wilt of Tomatoes**—One of the most striking results of the work on spotted wilt in tomatoes by Bald and Geoffrey (*Bull* 54, Commonwealth of Australia Coun Sci Ind Res, pp 24, 1931) is the

varied host range of the virus causing the disease *Nasturtium*, *Zinnia*, and Iceland poppy certainly show wide differences for a disease-producing agent which seems to direct its main activities against tomatoes. The tobacco thrip has been confirmed as an insect vector of the disease. *Frankliniella insularis* is shown to be another transmitting insect and to have an intimate relation to the virus. It is necessary that the larva feed on the diseased plant in order that the mature insect produced from it may be viriferous. The virus has been transmitted by mechanical methods, but an extract from a diseased plant loses its disease-producing capacity after standing a few hours. The extract is also rendered inactive by heating to 42° C for ten minutes—a low temperature in comparison with other viruses.

**Oil Origin and Accumulation**—Data of petroleum origin, migration, and accumulation for the oil-pools of the Nemaha granite ridge of Kansas and Oklahoma have been described by Mr J L Rich (*Bull Amer Assoc Pet Geol* for December 1931). These pools are mainly located at a widespread unconformity at the base of the Pennsylvanian shales, where these rest on the edges of Ordovician and Mississippian rocks. The evidence, coupled with that from an analysis of some later structures in the region, indicates that the hitherto assumed contemporaneity of the oil with those shales is suspect, in fact, it was clearly not generated until long after they were laid down, and its source cannot be sought in rocks in the immediate vicinity of the pools as they now occur. It appears possible that much of the oil was generated at a distant source from the present pools as a result of regional metamorphism, during the Appalachian revolution (Pennsylvanian-Permian), of older Palaeozoic rocks, any types capable of yielding petroleum by the mechanism of geodynamic and geothermal 'cracking' of organic mother-substances through the normal agencies of metamorphism would serve. The conclusion that the oil has thus migrated from a great distance is inevitable, possibly from the metamorphosed area in south-east Oklahoma, and if the Appalachian revolution was responsible, then we may fix generation, migration, and accumulation at this epoch with reasonable certainty. A sharply contrasted theory with those previously held, and a decided hint in other cases where contemporary deposition of oil from indigenous organic matter subject to biochemical change—a common postulate—is invoked.

**Forecasting of Indian Monsoon Rainfall**—In vol 4, No 37, of the *Scientific Notes of the India Meteorological Department*, S R Savur discusses the various formulæ used in seasonal forecasting in the India Meteorological Department since Sir Gilbert Walker placed the subject on its present mathematical basis in 1924. These formulæ connect future Indian rainfall with various meteorological data relating to different parts of the world that are available at the time that the forecast is made. A good deal of work has been done, especially by Fisher, since these formulæ were worked out, with the object of deciding with what degree of confidence multiple correlation coefficients of the kind used by Walker can be regarded as 'significant'. Use is made of this recent work in deciding which, if any, of Walker's factors are likely in the long run to be found insignificant, and which may therefore be discarded. The 1924 formulæ stand this critical examination on the whole very well, but certain factors have been found to be less important than was formerly supposed to be the case, and it is evidently the intention of the writer of this paper to try to find other factors that could replace those rejected. Thus, it appears, is likely to be a

difficult task, until it has been accomplished, the accuracy of the forecasting will remain at its present level, seeing that a mere reduction in the number of factors used cannot bring about any improvement. Such is the economic importance of the monsoon rains that the moderate measure of success already attained cannot be dismissed as of no practical value.

**Vibrations of a Lofty Building**—Mr T Fukutomi made some useful observations on April 25–May 25, 1931, on the vibrations of the Takeda Building in Tokyo (*Earthq Res Inst Bull*, vol 9, 1931, pp 485–507). This consists of an underground floor and nine other floors, and its total height is 99 ft. Tromometers of the same type were placed on the underground, fourth, and ninth floors, the intermediate one being removed to the sixth floor on May 16. As a rule, the building vibrated with a period of 0.4 sec, the amplitudes of the vibrations on the ninth, sixth, fourth, and underground floors being in the ratios 1.00 : 0.84 : 0.67 : 0.06. There is a diurnal period in the amplitude with its maximum epoch at 3 or 4 P.M., possibly due to the passage of tram-cars. During the month of observation, four sensible earthquakes were recorded, the mean maximum accelerations on the floors being as 1.00 : 0.42 : 0.26 : 0.24. On the underground floor, the direction of motion was nearly perpendicular to the line joining the origin and the building, on the ninth floor, it coincided very nearly with the direction of free vibration.

**Ultra-sonic Waves in Liquid Columns**—Vol 6 of the *Canadian Journal of Research* contains two papers from the National Research Laboratory, Ottawa, contributed by Drs R W Boyle, G S Field, and D K Froman, on dispersion and selective absorption in the propagation of ultra-sonic waves in liquids contained in tubes. The liquids were water, naphtha, castor oil, transformer oil, and chloroform, the tubes of glass, celluloid and cellophane of various thicknesses, and the oscillations were produced by the action of a high frequency electric circuit on a quartz or tourmaline piezo-electric oscillator. The frequencies were from 20 to 100 kilocycles per second and were measured by means of a Hertzian wave meter, and the velocity of phase propagation along the column by the distances apart of the nodes, which are indicated by the small bubbles which collect there. The authors find that the velocity varies with the frequency in the same way as the velocity of light varies on the two sides of an absorption band, and that the absorption is due to the conversion of the energy of longitudinal into that of transverse oscillations, the frequency of which is determined by the diameter of the liquid column, and for thin tubes is independent of the material and thickness of the walls of the tube.

**$e/m$  from the Zeeman Effect**—The accepted spectroscopic value for the ratio of the charge of an electron to its mass has been substantially confirmed in an investigation of the Zeeman effect of zinc  $\lambda 6362$  and cadmium  $\lambda 6439$  by J S Campbell and W V Houston (*Phys Rev*, Feb 15). This is of special interest, since recent values for the ratio obtained from cathode rays agree with those found from optical experiments, and the present measurements are made by a method very different from the earlier in detail. The splitting of the lines was produced by the field in an air-core solenoid consuming about 50 kilowatts, and was determined with a Fabry-Perot interferometer, yielding the result that  $e/m$  is  $1.7579 \pm 0.0025 \times 10^7$  e.m.u. per gram.

**Rates of Solution of Gas in a Liquid**—The commonly accepted theory of the rate of solution of a gas in a

liquid, due to Noyes and Whitney, assumes that a stationary film exists on the surface of the liquid and instantaneous saturation of the upper layer of this by the gas. The rate of solution then depends on the rate of diffusion of dissolved gas. Miyamoto (*Bull. Chem. Soc. Japan*, Jan.) points out that the thickness of the stationary film resulting from this theory,  $10^{-3}$ – $10^{-2}$  cm, is improbable, and he has examined the result of an assumption that among the molecules of colliding gas only those with component velocities normal to the surface greater than a threshold value can enter, and a similar relation holds for molecules escaping from the liquid. No assumption of a stationary film is made, which seems the correct procedure in the case of well-stirred liquids. It is shown that the new theory leads to an equation of the same form as the old one and in addition explains the results of experiments on the rate of oxidation of sodium sulphite solutions, stannous hydroxide, and ferrous hydroxide, previously made by the author, in a more satisfactory manner. The maximum rates of oxidation in all these cases are identical under the same conditions, and are governed by the maximum rate of solution of oxygen in water. The value of the threshold velocity of the entering oxygen molecules is calculated as 3.4 times the root mean square value at  $15^{\circ}$ – $35^{\circ}$ .

**Facsimile Radio Transmission**—Science advances with the ability to make measurements. During the last few years, mainly owing to the advent of short-wave transmissions with wave-lengths ranging between 14 metres and 50 metres, greatly improved methods of measurement have been introduced, and a new technique of echo and facsimile measurement has been developed. In 'facsimile' measurements, the

object is to record at the receiving end a pulse emitted at the transmitting end. In practice, the message is placed on a drum and a spot of light from a rotating optical system is caused to scan the message. The reflected light from the picture is led to a photo-cell. The output of the photo-cell modulates the transmitter. A similar optical system revolving in synchronism at the receiving end records the signals. In a paper on radio transmission, read to the Institution of Electrical Engineers on March 23, T. L. Eckersley utilises some of the phenomena observed in facsimile transmission to obtain information about the Kennelly-Heaviside layer. Facsimile records usually show a series of one, two, three, or more separate marks corresponding to the arrival by different paths of a single transmitted impulse. The differences in the times of arrival can be measured with high accuracy. It is from these measured time differences that the author finds the ray angles, heights of the effective layers, and the maximum electronic density in the Kennelly-Heaviside layer. For high angle transmission, for example, those recorded between Writtle near Chelmsford, and Somerton, in Somerset, the marks (echoes) are so regular that they can be definitely fitted into a multiple-reflection scheme. For shallow angle transmission the echo times are more irregular, and difficulty is experienced in fitting them into an optical scheme. Mr Eckersley calls a ray which has been reflected  $n$  times from the K H layer the  $n$ th order ray. A study of facsimile transmission from South Africa to Montreal shows that the high angle rays have greater attenuation than the lower ones. This suggests that at sufficient distances, only the lowest angle ray will survive, and perfect facsimile reproduction will result.

### Astronomical Topics

**New Comet**—Mr Carrasco, of the Madrid Observatory, discovered a comet of the twelfth magnitude on April 22. Several observations have been obtained, from which Miss Vinter Hansen and Mr Moller, both of the Copenhagen Observatory, have deduced the following elements:

|          |                        |
|----------|------------------------|
| T        | 1931 Dec 14 594 U T    |
| $\omega$ | $117^{\circ} 25' 07''$ |
| $\Omega$ | $17^{\circ} 43' 53''$  |
| $i$      | $58^{\circ} 11' 09''$  |
| $\log q$ | 0.394164               |

Thus the comet passed perihelion 4 months before discovery, and is now 3 units from the sun and 2 units from the earth. Dr W. H. Steavenson obtained the following observation at Norwood:

May 1d 0h 33 0m, R A  $12^{\text{h}} 6^{\text{m}} 40.98^{\text{s}}$ , N Dec  $22^{\circ} 1' 34.8''$  (1932 0)

This is very close to the ephemeris from the above orbit, which is continued below (for 0<sup>h</sup>):

|       | R A                                       | N Dec            |
|-------|-------------------------------------------|------------------|
| May 5 | $12^{\text{h}} 3^{\text{m}} 0^{\text{s}}$ | $20^{\circ} 41'$ |
| 9     | $11^{\text{h}} 59^{\text{m}}$             | $19^{\circ} 21'$ |
| 13    | $11^{\text{h}} 57^{\text{m}}$             | $18^{\circ} 1'$  |
| 17    | $11^{\text{h}} 55^{\text{m}}$             | $16^{\circ} 42'$ |

Dr Steavenson also obtained an observation of the comet Houghton-Ensor (so named because Mr G. E. Ensor discovered it independently at Pretoria on April 2)

April 30d 0h 17 2m, R A  $12^{\text{h}} 42^{\text{m}} 50.38^{\text{s}}$ , S Decl  $17^{\circ} 18' 43''$  (1932 0)

Dr Waterfield observed it at Headley on the same night, and considered that its magnitude was eighth or ninth, it was a fairly large object, with some central condensation. It is keeping very close to the

ephemeris of Cunningham and Whipple, which is as follows (for 0<sup>h</sup>):

|       | R A                                         | Decl              |
|-------|---------------------------------------------|-------------------|
| May 5 | $12^{\text{h}} 42^{\text{m}} 19^{\text{s}}$ | $S 8^{\circ} 3'$  |
| 9     | $12^{\text{h}} 42^{\text{m}} 30^{\text{s}}$ | $S 2^{\circ} 2'$  |
| 13    | $12^{\text{h}} 43^{\text{m}} 13^{\text{s}}$ | $N 2^{\circ} 51'$ |
| 17    | $12^{\text{h}} 44^{\text{m}} 25^{\text{s}}$ | $N 6^{\circ} 47'$ |

U. A. I. Circ 370 reports another remarkable object discovered by Dr Reinmuth at Königstuhl:

April 27d  $22^{\text{h}} 13^{\text{m}} 5^{\text{s}}$  U.T., R A  $13^{\text{h}} 42^{\text{m}} 7.8^{\text{s}}$ , S Decl  $10^{\circ} 41' 52''$  (1932 0), mag 12.5, Daily motion  $-4^{\text{m}} 56^{\text{s}}$ , S.  $4'$ , the retrograde motion in R A is greater than that of any of the known asteroids, so either it is a comet or an asteroid with a very abnormal orbit.

**Astronomical Photographs at Harvard**—The immense value of the great collection of astronomical photographs taken at Harvard Observatory is known to all astronomers. On many occasions it has enabled the history of novæ or variables to be traced for years before their discovery. Early images of Eros were also found upon them. Science Service announces in a bulletin dated March 23, that this valuable collection has now been placed in a new fireproof building at Harvard, where the plates are both safer and more easily accessible. It will be news to many that some plates of the collection go back to the year 1850, when the first photograph of a star ever taken was made at Harvard with the 15-inch equatorial. But it is only from the introduction of the dry plate in the early 'eighties that the series becomes continuous. The inauguration of the new building comes at an appropriate time, as Harvard is the appointed meeting place of the International Astronomical Union at the beginning of September.

## Research in Rubber Manufacture

THE twelfth annual report of the Research Association of the British Rubber Manufacturers, presented at the annual meeting of the Association on Feb 2, gives not only a succinct account of its varied activities but also a striking picture of the extent to which scientific research is serving the intellectual, technical, and material development of the rubber industry. Since the commencement of its career, the Association has contributed more than sixty papers to the scientific and technical Press, while nearly 25 per cent of the published matter in the *Transactions* of the Institution of the Rubber Industry from manufacturing sources originates from the Croydon laboratories. Apart from this, many confidential reports and circulars have been issued to members, and the scientific investigations carried out range from plasticity measurements on raw rubber, the comparison of Para, smoked sheet, and crepe, the properties of synthetic rubber or compounding ingredients such as litharge, accelerators and antioxidants, on the properties and testing of vulcanised rubber, to the numerous applications of vulcanised and hard rubber in tyres, cables and insulation materials, footwear, flooring, and proofings.

Joint investigations on cable insulation rubber have been carried out with the Admiralty, and on hard rubber and on a series of butadiene polymerisation products made by the I G Farbenindustrie A-G intended for use as insulation materials, with the British Electrical and Allied Industries Research Association. Testing apparatus has been devised which has simplified works' laboratory technique, and the cumulative value of the Association to the public, apart from the industry, is illustrated by the increased mileage of motor tyres, which as a result of research has increased from 2000 miles service in 1900 to 12,000, with an estimated car-mile saving of at least 4d, or an approximate saving to the public of £100,000,000 on tyres of 1900 quality. An increase of 1.2 per cent in the life of boots, shoes, hot-water-bottles, etc., due to the use of antioxidants would represent a saving to the public far greater than the amount payable to the Research Association under the levy scheme.

In view of these results, it is somewhat disappointing to find that finance is still causing the Association a good deal of anxiety. In part this is due to the increased responsibilities thrown on the Association by the advance of scientific knowledge, and to the growing use of its services by members and subscribers, but the adverse and uncertain general economic conditions of trade have been a further factor. In addition, the reduction of the grant from the Department of Scientific and Industrial Research from £2500 to £2000 for 1932 as a measure of national economy has placed on the industry itself the onus of finding resources for any expansion in the scientific services provided by the Association. It is accordingly the more unfortunate that, although passing its second reading, the Rubber Industry Bill made no further progress, owing to the congestion of Parliamentary business, and the expansion which the institution of the levy would make possible is still deferred.

Apart from its strictly scientific work, the Association participated in the successful negotiations between a committee representative of chemical interests generally and the British Engineering Standards Association which resulted in the formation of the British Standards Institution, covering the whole industrial field. The negotiations issued in a scheme providing for an organisation divided into four main

divisions dealing with building, engineering, chemical, and textile interests, the proposals thus representing the fulfilment of one of the recommendations of the Imperial Conference dealing with co-ordination of standardisation within the Empire. On the Chemical Division Council the interests of the rubber industry are represented by the India-Rubber Manufacturers' Association, but the matter of standardisation is one of prime importance to the Research Association and, during the year, preliminary consideration has been given to the internal organisation of the rubber industry for the formulation of specifications for manufactured rubber goods, and the Association has co-operated during 1931 in the preparation or revision of British standard specifications for moulded insulating material for general electrical purposes, rubber tubing for use with petrol, benzol, and paraffin, oil-resisting rubber tubing, rubber-jointing material, benzol and rubber belting.

Since there are no rubber organisations in the Dominions in any way analogous to the Research Association, apart from those in Ceylon and Malaya, the question of Imperial co-ordination in research scarcely arises in the rubber industry, but visits from representatives of the National Research Council of Canada and the Australian Council for Scientific and Industrial Research already afford a basis for some effective liaison when the systematic study of the problems of rubber manufacture is taken up in the Dominion or the Commonwealth. Close relations have been maintained between the Research Association and the Rubber Institute of Malaya, and a number of technical questions, such as the suitability of air-dried sheet for manufacturing purposes, the concentration and extraction of latex serum in bulk, latex emulsification problems, have been discussed between the two organisations. In addition, although with the imposition of a small cess upon rubber exports for the maintenance of the Ceylon rubber scheme, financial responsibility passed from London to Ceylon, by joint arrangement between the organisations in Ceylon and Malaya a scheme has been evolved for transfer of control to a Joint Advisory Council, thus securing continuance of the scientific investigations of the properties of the raw material and close co-operation between the producer and the manufacturer.

Co-operation with the Rubber Growers' Association has also been established, not only in publicity work on behalf of the industry, but also in the investigation of difficulties holding up the utilisation of rubber for various purposes, and the study of promising potential applications. Among such problems may be mentioned the utilisation of latex-oil emulsions as lubricants, the acoustic properties of rubber flooring for cinemas, the increasing of the resistance of rubber to oils, while such questions as the destruction of rubber by white ants, rubber goods for tropical railways, resistance of coloured rubber paving to light and weather, have been the subject of joint discussion. Co-operation in the study of problems confronting the utilisation of rubber has, however, by no means been confined to the Rubber Growers' Association. Investigations on ebonite have been carried on jointly with the British Electrical and Allied Industries Research Association, in which the Ceylon rubber research scheme and representatives of Government departments have participated. The War Office, India Office, Air Ministry, and Post Office are all represented on the Association's Tyre Research Committee, and co-operation with the motor industry and the British

Boot and Shoe and Allied Trades Research Association on problems relating to the manufacture and utilisation of rubber will undoubtedly develop

An important feature of the work of the Association is its library and information bureau, which serve the growing needs of all connected with the industry for a source of information and advice over a wide range of subjects. Without the regular issue of the monthly summary of current literature it would be difficult for the industry to keep itself abreast of all the latest developments, and when to this invaluable intelligence service there is added the issue of periodical circulars summarising the available knowledge on many scientific, technical, and economic subjects and the satisfying of an ever-growing number of inquiries (amounting to 690 in 1931 alone) covering all phases of the rubber industry, it can safely be asserted that the Research Association is rendering to the British industry services that are unsurpassed by the similar associations in Germany and Holland. In addition, a centralised organisation is able to carry out work of this kind much more thoroughly and efficiently than any one firm alone could hope to do, and avoids all the overlapping and duplication of effort which would occur if individual firms maintained their own organisations.

Already the number of cards in the index maintained by the Association amounts to well over 125,000, and the subject cards alone are increasing by about 14,000 a year. These statistics, however, give little idea of the magnitude of the work involved in cross indexing, and in the course of the work the library and information bureau has evolved its own system of classifying scientific, technical, and commercial information on rubber, based on a generalised decimal notation, although the International Brussels system was rejected on account of serious difficulties it offers in use for rubber information. The value of the work

of this section of the Association is further attested by the recognition of the library in 1930 by the Carnegie Trust as an outlier of the National Central Library. The generous grant made in accordance with that recognition has made it possible to expand considerably the library collection, and thus to improve further the utility of what is already a fully representative collection of all modern publications and particularly in regard to trade literature.

The above brief outline of the activities of the Association taken from the annual report gives some indication of the many services which the Research Association is rendering to the rubber industry, and illustrates the way in which that research reacts to the direct benefit of the public, as well as the tendency towards co-operative research between different branches of industry. One of the most surprising things in the report is the smallness of the staff with which this extensive and important work is being carried out. When we consider that as yet relatively little is known regarding the nature of rubber or the changes which occur during vulcanisation, apart altogether from the many problems presented by the utilisation of rubber, it is clear that the expansion in the work of the Association, and particularly the extension of systematic fundamental research which is anticipated as a result of the Rubber Industry Bill passing into law, should be of the utmost value and importance to the industry. Its practice cannot but be imperfect when the mechanism of the essential process is incompletely understood. The future of the rubber industry depends upon the wise, continuous, and adequate prosecution and application of scientific research, and the praiseworthy work already carried out by the Research Association indicates the possibilities when the industry as a whole devotes to the support of co-operative research the energy and financial support which it imperatively demands.

### Uses of Empire Timbers\*

UNDER the auspices of the Forest Products Research Board of the Department of Scientific and Industrial Research, inquiries are being carried out into the possible uses of Empire timbers. The results of the first year's investigations are given in the annual Report of the Board before us. Under the auspices of the Empire Timber Committee the work was started late in 1929, further facilities for the contemplated research becoming available by the end of last year.

Tests have been undertaken with East African camphor wood from Kenya for cabinet making, walnut and sapeli woods from Nigeria, both for cabinet making, and *Meranti tombaga* and Keruing timbers from the Federated Malay States, which might displace some of the Philippine timbers on the London market, provided they can be imported at competitive prices. New Zealand silver beech is to be tested for furniture wood at High Wycombe and in the making of rifle stocks at the Small Arms Factory at Enfield. Another subject reported upon is the investigations into the creosoting of British Columbian Douglas fir, since this timber might prove a considerable asset for railway sleepers. So far, Douglas fir timber has proved less easy to creosote than Baltic fir. By adopting the Canadian and American method of what is known as 'incising' over the sleepers, it was found possible to inject as

much creosote into them as the Baltic species will absorb.

The writers of the report comment upon the increased interest of the public in Empire timbers, for use in both Government and private buildings. But the opinion is stressed that the joint work of the Department and the Empire Marketing Board is not by itself sufficient to cover the necessities of achieving a general development and national use of Empire timbers. Unless production and marketing are closely co-ordinated with research, the work of the Board will be impaired. Apart from measures to be taken by the timber trade, it is stated that there is a lack of adequate official machinery for dealing with difficulties in the producing areas, more especially in certain of the tropical regions.

The difficulties, it is urged, could be largely overcome by comprehensive botanical and economic surveys of our forest resources, involving some enlargement of the facilities at the disposal of the Imperial Forestry Institute and the forest services, and by closer liaison and personal touch with the interests concerned in the country of origin. The suggestion of the enlargement of the facilities at the disposal of the forest services is timely at a moment when most of these services are being cut down owing to financial stringency.

The efforts of the departments responsible for the admirable work described in the report here dealt with require the careful consideration of the authorities responsible for forest administration in the various Colonies.

\* Department of Scientific and Industrial Research. Report of the Forest Products Research Board, with the Report of the Director of Forest Products Research for the Year 1930. Pp vii + 52 + 10 plates (London: H.M. Stationery Office, 1932) 4s net.



## University and Educational Intelligence

CAMBRIDGE—It is proposed to confer the degree of *ScD honoris causa* upon Sir William Bragg, director of the Royal Institution of Great Britain.

A lecture on the Liversidge Foundation will be delivered by Prof A V Hill, Foulerton Research Professor of the Royal Society, on Friday, May 13, at 5 P M, on "Chemical Wave Transmission in Nerve".

EDINBURGH—Sir Thomas Hudson Beare, professor of engineering, has been granted leave of absence, having been appointed leader of the official delegation from Great Britain to the Congress of the International Association for Bridge and Structural Engineering, to be held in Paris on May 19-25.

The Scottish Universities' Committee of the Privy Council has approved of a scheme for the affiliation to the University of the Heriot-Watt College. An ordinance is to be prepared in conformity with the provisions of the Universities (Scotland) Act, 1889, giving effect to the scheme.

Dr George W M'Crea, assistant in the Department of Chemistry, is exchanging for one year from Oct 1, 1932, with Prof Warren C Vosburgh, of Duke University, Durham, North Carolina, U S A.

MANCHESTER—Applications are invited for the Grisedale biological scholarship (botany or zoology, preferably the latter), value £200. The scholarship is offered to graduates who have already had some training in research. The latest date for the receipt of applications is June 1. They should be sent to the Registrar of the University.

THE London County Council is again offering two Robert Blair fellowships in applied science and technology, each of the value of £450 and each tenable for a year. The scholarships are for advanced study, and will be tenable in the dominions, the U S A, or abroad. Particulars and application forms are obtainable from the Education Officer (T 3), County Hall, S E 1. Completed forms must be returned by June 1.

THE twenty-third Conference of the Association of Teachers in Technical Institutions is to be held at Cardiff on May 14-17. The first public meeting will be on Whit Monday, when the Conference will be officially welcomed by the Lord Mayor of Cardiff, and the retiring president, Mr H Ade Clark, will induct the president for 1932-33, Mr S H Moorfield, Wigan and District Mining and Technical College. Among the topics to be discussed by the Conference are the relation of education and industry, junior instruction centres, junior technical schools, and recruitment for industry. An exhibition of books and apparatus will be held in the Technical College during the Conference.

## Calendar of Geographical Exploration

May 8, 1922—The Alps of Chinese Tibet

Prof J W Gregory, accompanied by C J Gregory, left Bhamo on the Upper Irrawaddy and went to Tengueh, covering 145 miles in 8 days. Thence they crossed the Salween and went to Yungchang, afterwards exploring a region completely unknown from the geological point of view, and very little known geographically. They reached the valley of the Yangtse Kiang after ascending the Loma Ho and discovering a series of hot springs. In 1893, Prof Gregory examined the East African Rift valley northward from Lake Naivasha to Lake Baringo, he is now on an expedition in the Andes.

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May 9, 1926—To the Poles by Aeroplane

Commander R E Byrd, with F Bennett, made the pioneer aeroplane flight to the north pole and back, from Spitsbergen. In 1928-29, from a base near the Bay of Whales, Byrd examined Marie Byrd Land, and also flew to the south pole and back.

May 10, 1553—Willoughby and Chancellor

Sir Hugh Willoughby, in the *Bona Esperanza*, accompanied by two other vessels, left Ratchliffe on a voyage which was intended to open a northern route to India. The equipment of the vessels was carried out under the direction of Sebastian Cabot, then an old man. On July 14 they landed on the Norwegian coast, in that region from which Othere had begun his voyage to the White Sea in the time of Alfred the Great. Two of the vessels reached the coast of Russian Lapland and found a good harbour at the mouth of the Arzina River, probably the modern Varzina, but during the winter Willoughby and all his men died, probably of scurvy. Russian fishermen found the two vessels and the corpses in the following year. Willoughby's will showed that he was alive in January 1554. The third vessel, the *Edward Bonaventura*, commanded by Chancellor, was separated from its two companions by a storm in August 1553, and reached the mouth of the Northern Dwina in the White Sea, where a small monastery existed and where the port of Archangel later developed as a result of Chancellor's voyage. Chancellor and his companions were invited to Moscow, and the route from England to Russia via Archangel was established shortly afterwards. The expedition thus had very different results from those expected by its promoters. Chancellor was wrecked near Aberdeen in November 1556, when conveying a Russian embassy and a cargo of goods from the Dwina River. He and his wife and seven Russians were drowned.

May 12, 1539—Discovery of the Mississippi

Hernando de Soto started from Havana, and landed in Espiritu Santo Bay, on the west coast of the present State of Florida, in search of the gold reported by Gabez de Vaca. He probably passed into Georgia as far as 35° N, then south to the region where Mobile now stands, and finally north-west to the Mississippi, which he reached in 1541. He wintered on the Ouachita, in what is now Arkansas and Louisiana, west of the Mississippi. On the return journey along the Mississippi, de Soto died in 1542, but his men, under Luis Moscoso de Alvarado, descended the river to the sea from a point near its junction with the Arkansas, the voyage occupying 19 days. Thence they coasted along the Gulf of Mexico to Panuco. This important journey was the first extensive exploration of the southern United States, it resulted in the discovery of the Mississippi, and gave to the world the first account of the social customs of the Indians of the southern States.

May 12, 1721—Greenland

A Norwegian missionary, Hans Egede, with his wife and family, sailed from Denmark, and landed on the west coast of Greenland near Godthaab. He lived there until 1736, and collected much information about the south-western districts and the Eskimo tribes. Greenland had been known to the Norse, Eric the Red having sailed there in 982 and spent three years in its south-western regions. The Norse colonies there flourished at first but died out in the fifteenth century, J Davis finding no trace of them in 1585. Egede's settlement led to renewed exploration and colonisation of the interior.

## Societies and Academies

## LONDON

Royal Meteorological Society, April 20—J N L Baker The climate of England in the seventeenth century Descriptive writings provide evidence of a somewhat inconclusive character, and this can be supplemented by the reports of the Venetian Ambassadors, published in the Calendars of Domestic State Papers (Venetian) and elsewhere The Calendars of Domestic State Papers furnish many scattered references, both to short periods and to long spells of weather, and from these a continuous account can sometimes be constructed They also include important tables of winds covering the periods 1667–72 and 1675–78 The MS diaries preserved in the Bodleian Library are also of value That of Dr Napier covers the period 1598–1635 but is very fragmentary that of Elias Ashmole only extends from 1677 to 1685 but is unusually full Most of this evidence has not previously been used, and an attempt has been made to correlate it with the accepted rainfall figures of Townley and Derham and other records, such as the diaries of Evelyn and Pepys In a number of cases the older evidence is unreliable, at the same time, all the evidence is of an unscientific nature, and strict comparison with reliable evidence of modern times is apt to lead to erroneous conclusions—C W G Daking The meteorology of Kamaran Island (Red Sea) The upper winds of this region would have played a big part in the journeys of the air-ship *R 101* to India and back, and it was probably because this information would have been so valuable that observations were commenced at Kamaran Island In most respects, the climate experienced is typically tropical, but it is noteworthy that, for so small an island, the conditions are as trying as those experienced inland on the continents of Africa and Asia—David Brunt Notes on radiation in the atmosphere (1) The absorption spectra of water vapour and liquid water are applied to consider the justification for regarding cloud sheets and fog as black body radiators Long wave radiation from the atmosphere fits very closely a formula only involving the absolute temperature and the vapour pressure The fall of temperature after sunset on clear nights is closely proportional to the square root of the time from sunset The tendency to instability is greatest for clouds of medium height

Geological Society, March 9—W G Tidmarsh The Permian lavas of Devon With the exception of certain members in the south of the area, these are intermediate rocks, ranging from types resembling basalts to normal and olivine minettes Details of various lavas and analyses of fourteen rocks and three minerals are presented—B Jones The geology of the Farbourne-Liwyngwil district, Merioneth The area is occupied by a westward extension of the Upper Cambrian and of the Ordovician rocks of the Arthog-Dolgelley and Cadei Idris districts, and the sequence is, in general, similar to that in those districts, with, however, certain noteworthy differences An unexpected discovery was that of a wide expanse of Bala beds extending along the Dysynni valley and north of the Tallylyn (Bala) fault

## PARIS

Academy of Sciences, March 21—H Deslandres Simple relations between the molecular spectrum and the structure of the molecule From a study of the infra-red spectra of binary molecules the author has deduced the formula  $\nu = 1062 \cdot 5 q'/r's'$ , where  $\nu$  is the frequency,  $s'$  the number of external electrons excited

in one of the atoms,  $q'$  and  $r'$  being integers The possible meaning of this formula is discussed and some further applications given—M de Broglie, F Dupré la Tour, L Léprince-Ringuet, and J Thibaud The effects of ionisation observed in the presence of the beryllium rays under the excitation of the  $\alpha$ -rays from a bulb containing radium emanation—C Matignon, Kling, and Florentin The transformation of saturated acyclic hydrocarbons into ethylenic hydrocarbons Details of the products obtained by the action of catalysts upon ethane, propane, and butane at temperatures ranging from 500° to 650° C The catalysts used were copper and nickel, both on pumice—André Blondel The cyclic impedances of an earthed polyphase cable—C Camichel, L Escande, and G Sabathe The similitude of vortices—Emile Guyenot, Miles K Ponce and J Wietrzykowska The luteinisation of the ovary and masculinisation in the guinea-pig—Jean J Placinteanu The deduction of Maxwell's equations with the aid of Eddington's wave tensor—C E Winn The oscillation of the means of Holder and of Cesàro—Georges Bouligand Some points of the theory of ensembles—Louis de Broglie The densities of mean values in Dirac's theory—Nicolas Kryloff and Nicolas Bogoliuboff The phenomenon of the establishment of the silent zone (*entraînement*) in radio technique—J F Cellierier The phonic test for the measurement of the mechanical intensities of sounds—François Boissier A new iodine accumulator This battery is based on the reversible reaction  $ZnI_2 = Zn + 2I$  Its e m f is 1.2 volts and efficiency about 80 per cent—Pierre Jolibois and Georges Fourrier The photographic registration of pH during reactions in solution The apparatus described in a previous note for recording the electrical conductivity of an electrolyte as a function of the quantity of reagent added has been modified to give a record of the pH of a solution A reproduction of the curve obtained by the neutralisation of orthophosphoric acid by soda is given—H Colin and Mlle A Chaudun The action of neutral salts on the inversion of sugar by acids—René Dubrisay A phenomenon of capillary chemistry A solution containing a mixture of sodium laurate and oleate is made to foam by passing a current of air or nitrogen Analysis of the froth and residual liquid confirmed the theoretical view that the ratio oleic acid to lauric acid was higher in the froth than in the residual solution—Ed Chauvenet and J Tonnet The anhydrous combinations of thoryl chloride with the alkaline chlorides—L Bert and E Andor The bromination of  $C_6H_5 \cdot O \cdot CH_2 \cdot CH \cdot CHCl$ —R Cornubert and P Robinet The phenomena of isomerism in the tetrahydropyrones—M Grunfeld The relation between the ultra-violet absorption spectra and the reaction velocities for certain classes of amines—Marius Badoche Researches on the coloured hydrocarbons a blue hydrocarbon—L Royer The orientation of crystals of the epsomite series by mica—Mlle Lucienne George The origin of the Gnetaleæ—D Montet The effect of radioactivity on the germination of bulbs—H Hérissé and J Laforest A heteroside extracted from the Portuguese laurel, *Cerasus lusitanica*—Philippe Fabre The utilisation of electromotive forces of induction for the registration of the variations of velocity of conducting liquids a new hamodromograph without a paddle in the blood The apparatus is based on the e m f due to induction developed in any moving conductor in rapid motion in an intense magnetic field—H Simonnet and G Tanret Some physiological properties of nerine and other proximate principles of the oleander The glucosides of the oleander are cardiac glucosides—A Machebœuf and G Sandor Study of the extraction of the lipides of blood serum by ether in presence of

alcohol The ratio of ether to alcohol for maximum extraction must fall between narrow limits the time of contact is also important —Jean Roche The action of oxygenation on certain physico-chemical properties of the hæmocyamine of the snail —C Mathis and C Durieux The identity, at Dakar, of *Spirochaeta Duttoni* var *crocodyræ* and the spirochaete naturally infecting *Ornithodoros erraticus*

## VIENNA

Academy of Sciences, Jan 14 —Leopold Schmid and Walther Rumpel Constitution of the colouring matter in toad-flax flowers (*Linaria vulgaris*) It was found earlier that this colouring matter contains a molecule  $C_{17}H_{14}O_6$  united to form a glucoside with one molecule of a hexose and one of a methylpentose It is now shown that the coloured constituent is the 4,6-dimethyl ether of scutellarein The flowers contain also entricontane and mannitol —Julius Donau A new micro-gravimetric analytical process A combined precipitating and filtering dish with a platinum-foil cover and with platinum black as filtering layer, is described Dissolution, precipitation, washing, and drying are carried out in the same vessel and losses of precipitate thus entirely avoided Accurate results have been obtained in the determination of chlorine, iron, sulphate, and potassium chloride —Robert Janoschek Geology of the Brenner Hills —Karl Linsbauer Nuclei, nucleoli, and movements of the plasma in the vesicular cells of *Mesembryanthemum cristallinum* —Gustav Jantsch and Ernst Wiesenberg Higher valency compounds of the rare earths (1) Lanthanum oxide —Martin Gusinde and Viktor Lebzelter Somatology of the Indians of Tierra del Fuego Sixty years ago the three different aboriginal races of Tierra del Fuego numbered together about 12,000 members, but it is estimated that less than 300 of pure descent now remain The region peopled by each of these races is sharply defined and little mixing occurs Their modes of life vary, the Yamana and Halakwalup being water-nomads and the Selk'nam hunter-nomads The results of anthropological measurements of a number of individuals of each tribe are given —Otto Sickenberg A new antelope, *Parurhætherium rugosifrons*, 107 gen nov spec, from the Lower Pliocene of Samos

Jan 21.—Contributions to the knowledge of the climate of towns (1) Hanns Tollner Distribution of temperature in Vienna in the summer of 1931 —(2) Friedrich Lauscher and Ferdinand Steinhauser Radiation in Vienna and its neighbourhood —Fritz Vessely and Editha Nadler Substances contained in the root of *Pimpinella saxifraga* (2) In addition to pimpinellin and isopimpinellin, previously described, this root contains also a third compound of the same class, namely, isobergaptene, to the molecule of which a three-ringed structure is ascribed —Fritz Vessely and Ferdinand Kallab A re-arrangement in the flavone series —Leopold Schmid and Anton Seefeldt The colouring matter of the yellow dahlia This colouring matter comprises, besides apigenin, also a deep yellow compound,  $C_{15}H_{10}O_6$ , which melts at  $324^\circ$  and contains three hydroxyl groups and a -hydroxybenzoic acid residue in its molecule —Karl Jorsch Action of ammonia and amines on esters of unsaturated acids (1) Action of ammonia, methylamine, and diethylamine on ethyl crotonate —Franz Uhrmann Biochemistry of the luminous bacteria (1) Influence of sodium and potassium chlorides and bromides —Karl Strubecker Rhombic nets of straight lines and circles —Alfred Tarski Concept of truth in the language of the deductive sciences

## Forthcoming Events

## FRIDAY, MAY 6

IRON AND STEEL INSTITUTE (at Institution of Civil Engineers), at 10 A M —Annual Meeting  
ROYAL SOCIETY OF MEDICINE (Otolaryngology Section) (Annual General Meeting), at 10 30 A M —Discussion on Labyrinthitis  
CAMBRIDGE UNIVERSITY (in Senate House), at noon —Prof A Einstein Die Theorie der Elektrizität im Rahmen der allgemeinen Relativitätstheorie (Rouse Ball Lecture)  
INSTITUTION OF MECHANICAL ENGINEERS (London Spring Meeting), at 2 30 —A Binns Recent Developments in the Mechanical Equipment of the Port of London Authority —At 7 30 —J H Boyd The Building of a Modern Motor-car Manufacturing Plant  
ROYAL SOCIETY OF ARTS (Indian Meeting), at 4 30 —Miss B M le P Power Indian Labour Conditions  
ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5 —Annual General Meeting  
PHYSICAL SOCIETY (in Physiological Laboratory, University College), at 5 —Prof A V Hill The Measurement and Analysis of the Heat Production of Nerve (Lecture)  
UNIVERSITY COLLEGE, at 5 30 —Sir Bernard Pares Russia and the West (Lecture)  
GOLDSMITHS' COLLEGE (New Cross), at 5 45 —Prof J F Unstead Recent Developments of the Regional Method—as applied to Teaching  
ROYAL INSTITUTION OF GREAT BRITAIN, at 8 30 —Conve-sazione  
ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8 30 —Annual General Meeting  
CAMBRIDGE UNIVERSITY (in Anatomy Lecture Room, New Museum) —Prof J J R Macleod Linaere Lecture

## SATURDAY, MAY 7

GOLDSMITHS' COLLEGE (New Cross), at 3 30 —Prof H J Fleure Social and National Ideals in their Geographical Settings—A Study of Some European Problems

## MONDAY, MAY 9

UNIVERSITY COLLEGE, at 2 —Dr W W Greg The Descent of Manuscripts (Lecture)  
ROYAL INSTITUTION OF GREAT BRITAIN, at 5 —General Meeting  
INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6 15 —Annual General Meeting  
BRITISH ASSOCIATION OF CHEMISTS (Notts and Derby Section) (Annual Meeting) (at King's Café, Derby), at 7 15 —A W Knapp and others Discussion on the Organisation of the Profession  
MEDICAL SOCIETY OF LONDON (Annual General Meeting) (at 11 Chandos Street, W 1), at 8 —At 8 30 —Sir James Berry Fallen Idols (Annual Oration)

## TUESDAY, MAY 10

ROYAL HORTICULTURAL SOCIETY (Greycoat Street, S W 1), at 3 30 —Sir Frederick Keeble Garden Fertility (Masters Memorial Lectures) (1)  
ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section) (Annual General Meeting), at 5 —Discussion on Some Problems concerning the Prevention and Treatment of Acute Rheumatic Infection  
INSTITUTION OF CIVIL ENGINEERS, at 6 —Annual General Meeting  
BRITISH ASSOCIATION OF CHEMISTS (Birmingham Section) (at Chamber of Commerce, Birmingham), at 7 30 —Annual Meeting  
(NEW) INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS (British Branch) (at Institution of Mechanical Engineers), at 7 30 —Dr W Rosenham The Work and Objects of the Association  
ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8 30 —Annual General Meeting  
ROYAL INSTITUTE OF PUBLIC HEALTH (at Belfast) (continued on May 11 to 15)

## WEDNESDAY, MAY 11

- ROYAL HORTICULTURAL SOCIETY (Greycoat Street, S W 1), at 3 30—Sir Frederick Keeble Garden Fertility its Origin and Maintenance (Masters Memorial Lectures) (2)
- ROYAL SOCIETY OF MEDICINE (Surgery Sub-Section of Proctology), at 5—Annual General Meeting
- NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (at London School of Economics), at 5 30—Dr C S Myers Psychological and Social Factors in Business Rationalisation (2) The Dangers of Rationalisation
- SCHOOL OF ORIENTAL STUDIES, at 5 30—Dr Pran Nath Indus Inscriptions
- INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (Annual General Meeting) (at Cleveland Technical Institute, Middlesbrough), at 7—E H E Woodward and W A Carne An Analysis of the Costs of Electricity Supply and its Application in Relation to Various Types of Consumers
- INSTITUTE OF METALS (at Institution of Mechanical Engineers), at 8—Prof F Korber The Plastic Deformation of Metals (Annual May Lecture)

## THURSDAY, MAY 12

- UNIVERSITY COLLEGE, at 5 30—Prof W R Hess The Autonomic Nervous System (1) (*Succeeding Lecture on May 13*)
- IRON AND STEEL INSTITUTE (Additional Meeting) (jointly with Staffordshire Iron and Steel Institute) (at Chamber of Commerce, Birmingham), at 6 30—Presentation of Papers
- OIL AND COLOUR CHEMISTS' ASSOCIATION (London Section) (Annual General Meeting) (at 30 Russell Square, W C 1), at 7 30—S K Thornley Development of Government Intervention and its Effect on our Industry
- OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7 30—Annual General Meeting, followed by Ordinary Meeting

## FRIDAY, MAY 13

- ROYAL ANTHROPOLOGICAL INSTITUTE (Sociological Research Committee), at 5 30—J H Driberg Economic Stages of Development in Africa
- BRITISH ASSOCIATION OF CHEMISTS (London Section) (at Broad Street Station Restaurant, E C), at 7—Annual General Meeting
- INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Cowdry Hall, Aberdeen), at 7 30—Prof J K Catterson-Smith Everyday Uses of Electricity (Faraday Lecture)
- ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Sir John C W Reith Broadcasting
- INTERNATIONAL COMMITTEE ON THE HISTORY OF SCIENCE (at Paris) (*continued on May 14 to 16*)

## SATURDAY, MAY 14

- ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS (Annual Conference) (at Technical College, Cardiff) (*continued on May 15 to 17*)

## Official Publications Received

## BRITISH

- Transactions and Proceedings of the Perthshire Society of Natural Science Vol 9, Part 2, 1930-31 Pp 35 68+21-22+plates 12-17 (Perth) 3s 6d
- The Hastings and East Sussex Naturalist the Journal of the Hastings and St Leonards Natural History Society Edited by Anthony Belt Vol 4, No 5, 31st March Pp 93 120 (St Leonards) 2s
- The University of Sheffield Report on Research Work carried out in the Departments of Mining and Fuel Technology during the Session 1930-31 Pp 18 (Sheffield)
- Royal Botanic Gardens, Kew Bulletin of Miscellaneous Information Appendix 1, 1932 Review of the Work of the Royal Botanic Gardens, Kew, during 1931 Pp 54 (London H M Stationery Office) 1s 4d net
- The Ninety eighth Annual Report of the Royal Cornwall Polytechnic Society New Series, Vol 7, Part 1, 1931 Pp vi+106+16+5 plates (Camborne) 5s
- Air Ministry Aeronautical Research Committee Reports and Memoranda No 1418 (Ae 534-T 2986) Wind Tunnel Experiments on the Cowling of Air Cooled Engines By W G A Perring Pp 49+21 plates 2s 6d net No 1438 (T 3149) Wind Tunnel Experiments on High Tip Speed Airscrews By A S Hart-horn and Dr G F Douglas Pp 12+8 plates 9d net (London H M Stationery Office)

- Oxford Bibliographical Society Proceedings and Papers, Vol 3, Part 1, 1931 A Bibliography of the Honourable Robert Boyle, Fellow of the Royal Society By J F Fulton Pp 172 (Oxford) 10s
- Department of Scientific and Industrial Research Forest Products Research Leaflet No 5 Empire Timbers from Home and Overseas for Building and Structural Purposes—Timbers and the Uses for which they are considered as generally suitable By Major J R Cosgrove Pp ii+24 (London H M Stationery Office) 1s 3d net
- Transactions of the Institution of Electrical Engineers Edited by P F Rowell Vol 70, No 424, April Pp 393 476+xx (London E and F N Spon, Ltd) 10s 6d
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SATURDAY, MAY 14, 1932

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## The Training of Archæologists

CONDITIONS at the present moment can scarcely be regarded as propitious for any new undertaking in scientific teaching or research which looks to the financial support of the public for its funds, but the appeal for £30,000 to found an archæological institute in the University of London, which has been launched by Sir Charles Peers, and to which he made reference in his presidential address to the Society of Antiquaries on April 28, is more than justified, even if it were only on the ground of its urgency. It has the backing of the heads of the principal learned societies and other bodies in London which are interested in archæological studies, and it will receive cordial endorsement among those who are acquainted with the difficulties which, in present circumstances, hamper the organisation of these studies, not only in London, but also in other educational centres where archæology is a recognised subject of instruction.

The Board of Archæological Studies in the University of London has had the proposal for an institute of archæology under consideration for some time. It has now become urgently necessary that some decisive action should be taken at once. The plans for the new university buildings in Bloomsbury are in course of preparation, and provision is being made for the accommodation of the Institute of Historical Research and the Institute of Art. It is only fitting, and indeed it is eminently desirable, that, if the University is to have an Institute of Archæology at all, it should be in the same building. The immediate proximity of three departmental institutions dealing with subjects so closely allied will obviously add greatly to their usefulness by facilitating interchange and cross-reference in the consultation of books and other material available for study and research.

In the proposal now put forward, it is not intended that the Institute of Archæology should constitute a separate teaching school of the University. The present teaching arrangements in archæology will be unaffected, except in so far as the Institute will afford an opportunity for practical instruction in archæology along certain lines. It will be a place of training but not of teaching in the academic sense, it will be equally available for students of all descriptions from all parts of the world and in all branches of archæology, and it will be equipped under the three main heads of materials for study, laboratory, and library. Its main function will be the instruction of the student in the practical methods and technique of

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archæological investigation in the field and in the archæological workshop—the workshop, that is, in the wider sense in which it covers the classification and serial arrangement, as well as the material preparation for study, of the objects accruing in the course of archæological exploration.

Archæologists have long been convinced of the urgent necessity for the establishment of such a place of training. The demand for the services of trained men, or women, in the field is now far in excess of the supply. The remarkable, not to say at times sensational, discoveries made since the War, in Egypt, in Mesopotamia, and in India, have stimulated public interest in archæological studies, with the result that it has been possible greatly to extend the field of archæological investigation, while the trend in the development of archæological theory has been such as to press on the simultaneous investigation of sites which, at one time, it might have been considered possible to postpone, as less urgent, for examination in orderly rotation.

This increased activity involves a heavy drain on the man-power of archæology—it demands a more intensive training in the direction of both a more highly specialised technical equipment and a wider comparative knowledge, not merely of the general trend of development, but also of details of cultural characteristics and manifestations in the various more or less related provinces of archæological discovery. It would, for example, be hazardous, at the present stage of our knowledge, to attempt to fence off as irrelevant any one province between Western Europe and China at certain periods of pre-history. Such conditions, obviously, make heavy demands on the knowledge of an archæologist outside his special province.

It is, however, in the development of technical methods, both of excavation and salvage, that progress recently has been marked, and in which much is required of the investigator. Not so very long ago, the leader of an archæological expedition often had to improvise methods of salvage and recording his discoveries on the spur of the moment. Now the worker in the field must be equipped with a wide range of technical knowledge, embracing more than a mere nodding acquaintance with the chemical and physical properties and reactions of the material with, in, and on which he works, or which it may be possible or expedient for him to employ in given conditions. So great, in fact, has been the advance in these requirements that a recent report on an archæological investigation refers to the work of a predecessor on the same site only twenty years before, who for that time

was highly trained, in terms which might have been applied to the Dark Ages.

The work of British archæologists in the field, is generally conceded, and not without reason, holds a foremost place in the scientific study of archæology throughout the whole world on the score of its vision, its meticulous care in carrying out the work of excavation, and in the accuracy of its observation and record. The credit for this is largely due to great excavators such as Sir Flinders Petrie and Sir Arthur Evans, to name two of the best known only. By their example, by precept and in many instances by actual instruction, the leaders in archæological research have inculcated scientific methods of investigation in younger men who have carried on their tradition and helped to develop its principles. British archæology, too, has been fortunate in that bodies such as the Egypt Exploration Society and the Schools of Archæology in Egypt, Athens, Rome, Palestine have been able by the continuity of their operations from year to year, to afford an unrivalled field of training to the archæological recruit, such as for long was open to the archæologist of almost no other country.

Leaders of archæological expeditions, however, are busy men, and the calls on their time, even the calls of day-to-day routine, are heavy and seem to be on the increase. It is becoming more and more difficult for them to devote themselves in an appreciable degree to the training of younger colleagues in carrying on the work. The conditions of the past, in fact, are no longer possible, nor are they adequate either to the needs of a modern scientific expedition or of the individual. A training institution of some kind must, perforce, be provided in their place. To a limited extent the British Museum has been able to meet the deficiency in one branch of training, the technique of cleaning, preserving, and repairing such material objects as are usually found in the course of excavation, by generously placing its laboratories at the service of a limited number of students. But to act as a school is not the function of a museum, nor can it display for the benefit of students the endless series of objects—potsherds, for example, of which there is a valuable but inaccessible store in London—which are essential to the needs of the beginner in archæology, but of little interest to the general run of those who wish to consult the collections of a museum.

In this connexion, it must be pointed out that the museum worker in archæology is in need of training equally with the man in the field. Ideally each should know something of the work of the



other, and conditions similar to those which militate against the instruction of juniors in the elementary principles of practical archæology while in the field are becoming increasingly prevalent in our museums

A brief reference must be made to the needs of comparative study. From the nature of the case, this cannot be carried to any great length in an institute such as is contemplated, nor is it probable that a minutely detailed treatment will be necessary. Provision, it is suggested, will be made for the study of the cultural development of the different centres by the display of original material, supplemented by series of casts sufficiently complete to give a general conspectus of the artistic tradition in each. The use of casts is a very necessary measure in view of the scattered distribution of archæological material in widely separated collections, and the increasing sentiment against the export of antiquities from their country of origin.

Nothing would appear to have been said, at least as yet, as to the possibility of any provision by the Institute of facilities for practical work in the field, that is, in actual excavation—beyond question an element of the first importance in any scheme of training which sets out to be practical. The participation of the students of one of the constituent colleges of the University of London in a succession of small 'digs' on archæological sites proved eminently successful in stimulating keen interest, and in at least one case revealed an unexpected *flair* for archæological investigation. No doubt, even if it should be found impracticable for the Institute itself to work on these lines, arrangements with other bodies carrying out excavations within a reasonable distance of London might well be possible, especially as facilities for observation and participation in the work of excavation have already been granted students on at least one site.

The fact that a concrete proposal for a school of archæological training has been put forward in connexion with the University of London renders nugatory any discussion whether a more suitable situation or greater facilities might have been obtained elsewhere, whether at Oxford or Cambridge with their valuable archæological collections and their powerful if imponderable traditions of the study of antiquity. In any event, the congregation of the great national collections in London would go far to weigh down the scale, while the attraction to overseas visitors of an Institute which throws open its doors to all comers gives the central position of London in relation to the outside world an irresistible claim.

### The Butterflies of America

*The Butterfly Book a Popular and Scientific Manual, describing and depicting all the Butterflies of the United States and Canada* By Dr W J Holland (The Nature Library) Pp xii + 424 + 77 plates (Garden City, N Y Double-day, Doran and Co, Inc, 1931) 10 dollars

THE second edition of Dr W J Holland's "Butterfly Book" brings the subject matter up to date. The text has to a large extent been rewritten and a number of plates have been added, all the species of butterflies occurring in America north of Mexico being depicted, with the exception of a few obscure or doubtful ones. The introduction deals with collecting, breeding, preserving, and classifying specimens, and with manuals, catalogues, and check-lists of North American butterflies. The generic descriptions are illustrated by text-figures of wing-venuration, and occasionally by some additional detail of structure. The descriptions of species are kept as short as possible, the life-history, if known, being added, and the distribution of each species and variety noted. The interpolated chapters of an anecdotal or educative nature are very pleasing interruptions of the necessarily dry and monotonous descriptive text. A complete alphabetical index greatly facilitates the use of the book.

In estimating the merits of a volume of this kind, the reviewer has two lines of approach, giving views at two different angles. the critical examination of the subject matter, and the estimation of the influence of the book on the public. The "Butterfly Book" is primarily a manual for the lover of Nature who devotes his leisure hours to Lepidoptera in one way or another. Its great value consists in supplying a want for a non-expert public which requires a guide in its search for information.

It is essential for the welfare of the human species that this point of view should be understood and acted upon by the advanced man of science. Many biologists of our time are unfortunately only too prone to consider their own corner in science to be the only one worth occupying, forgetting that although the inevitable overcrowding of the earth will necessitate the application of biological principles to human relations, biology will not attain the foremost position it ought to occupy in all councils governing life unless there is a large body of people willing to listen to the biologist and capable of understanding the bearing of his teaching. It is of little avail to try to educate reluctant or even hostile governments steeped in antiquated

notions of the interrelation of human beings with each other and with the environment

The 'mere' collectors are the important persons, and the more there are of them the easier it will be to introduce an outlook on life conforming to the principles of biology. Dr W J Holland's book is one of the best means of attaining this much-desired end. It is most pleasing and encouraging to read in the introduction that more than 65,000 copies of the first edition have been distributed—an astonishing result. It may safely be predicted that the second edition will also be a 'best seller'. We have here proof that, in North America no less than in Europe, there is a large biologically-minded public, it is for the advanced biologist to encourage it and to be its leader.

The specialist in Lepidoptera will welcome the new edition particularly on account of the many figures of types depicted on the additional plates. As taxonomists, whether amateur or professional, were not (and are not) always careful in the labelling of the specimens on which they based descriptions of new species, and as the method of selecting one specimen as type was formerly not in general use, one or the other reputed type may in reality be an individual added to the collection after the publication of the original description. Dr Holland states his reasons for accepting as type or typical this or that specimen figured, and if a sceptic should not agree with Dr Holland in every instance, he will have to defeat Dr Holland by positive arguments, which is a much more difficult task than the mere expression of doubt.

The nomenclature employed is conservative, Dr Holland being particularly emphatic, and rightly so, in rejecting the Tentamen of Hubner, a printed questionnaire of 1805 containing names which some authors, mistaking them for generic names, have adopted, causing thereby much unnecessary confusion. The author divides the butterflies into seven families: Nymphalidæ, Libytheidæ, Riodinidæ, Lycænidæ, Pieridæ, Papilionidæ, and Hesperidæ. The reviewer heartily agrees with him in uniting the Danainæ, Satyrinæ, etc., with the Nymphalidæ in one family, all these butterflies being indeed nothing but diverse developments of one large branch separate from all the other butterflies. The genus *Libythea*, which has a lonely position as occupier of a house of its own, should also have been placed with the Nymphalidæ, but the error, a hundred years old, of considering it nearly related to the Riodinidæ, dies hard, and Dr Holland here follows the ill-considered opinion of the overwhelming majority of lepidopterists, at

whom *Libythea* itself disdainfully turns up its long nose. In the species and varieties, the author adheres to the convenient but scientifically incorrect method of treating the accidentally first-described form of a species as *the* species, and the other forms, which as a rule are really co-ordinated with the first-described one, as varieties of it—a method which leads to phylogenetic inconsistencies.

However, these points do not impair the usefulness of the "Butterfly Book", either for the beginner or for the expert, and will deter nobody from acquiring the handsome volume. Considering the large number of coloured plates, the book could be offered at the moderate price of 10 dollars only in expectation of very large sales. Dr Holland, who finished the manuscript on his eighty-second birthday, is most heartily to be congratulated on this achievement. It was a laborious task successfully carried through in consequence of the author's great experience, boundless energy, and deep love of Nature.

KARL JORDAN

### The Fascination of Things Inanimate

*Inorganic Chemistry* By Prof T Martin Lowry.  
Second edition. Pp xiv + 1101 (London: Macmillan and Co, Ltd, 1931) 25s net

A NEW edition of Lowry's "Inorganic Chemistry" is a welcome event, especially since the author, taking advantage of the necessity to reset the text, has materially altered and improved its structure so as to take full account of many developments in chemistry during the last ten years. He evidently believes that anything which is really true is amenable to simple explanation, if we will but take the trouble, and a commendable feature of his book, a direct outcome of clear thought and plain words, is that it presents satisfactorily many matters which are new or are commonly regarded as difficult.

The historical and introductory chapters remain much as before, and a reperusal of them strongly reinforces the old impression of their sound and attractive character. To begin, as the author does, with substances and their fundamental properties, and pass on at once to practical methods of purification and tests of purity and to means of identification of pure substances, is indeed to put first things first. It is too easy for the pedagogue to forget that the primary duty of the chemist is to know and handle all forms of matter. On this point the author is very sound. With quiet, sustained enthusiasm, which may be inferred from the care and clarity of his descriptions, he develops

and displays the sheer interest and beauty inherent in the curious, unexpected, even perverse behaviour of inanimate material

From general fundamental ideas, the author passes to consider in turn salts, alkalis, and acids, the calcination of metals, chalk and lime, the burning of carbon and the composition of fixed air, and the burning of hydrogen and other combustible gases. This brings in, naturally, vividly, and accurately, a great part of the earlier history of chemistry, and provides material and reason for the consideration that follows of the laws of chemical combination and the atomic theory.

A review of the properties of gases (which is particularly well done) leads up to Avogadro's hypothesis and the Cannizzaro method for atomic weight, the application of which is illustrated very clearly by a table of data yielding the atomic weights of hydrogen, oxygen, chlorine, and carbon. This leads to a consideration of other methods of determining molecular and atomic weights, and a discussion of solutions and the colligative properties of dissolved substances whereby their molecular weights are ascertained. Having thus touched, naturally and effectively, upon many essential principles usually branded as 'physico-chemical', we pass on to the distillation and crystallisation of mixed liquids, illustrated by some clear and well-chosen phase diagrams and photomicrographs, and to an outline of the phase rule. Then, by way of electrolysis and typical cells, the author introduces the ionic hypothesis, not shirking the theory of complete ionisation, and discusses the types of valency. As the last item in this review of general theory there is an admirably clear and interesting chapter on the form and structure of crystals.

Reading this part of the book, about a quarter of the whole, one has the sense of a smooth, orderly, and efficient progression of argument. The doubts and pitfalls are not evaded, they are, indeed, clearly and carefully pointed out, but, using what is firmly established, the foundations of chemistry are neatly and strongly laid.

In Part II of the book, devoted to the non-metals, the matter presented is for the most part that usually found in the larger textbooks. We may remark, however, the inclusion of ortho- and para-hydrogen, a good section on flames (though it seems a pity to omit a diagram of the Smithells flame-separator), a reference to dense ice, and good brief outlines of our knowledge of free radicals and of the theory and practice of the liquefaction of air and hydrogen. As examples of the care that

has been taken to bring the matter up to date, the inclusion of fluorine monoxide and hydrogen pentasulphide may be cited. Special praise must also be given to a very full and clear account of the chemistry and constitution of the silicates.

Since authors (and critics) are human, some points may be found, of course, for criticism. For example, the failure to mention any commercial ozoniser, the omission of any reference to the preparation of pure chlorine by thermal decomposition of auric or platonic chloride or to the practical methods of making perchloric acid from sodium or ammonium perchlorate. Also, it might be said that the chlorides of iodine are dismissed too lightly and without any reference to the monotropy of the monochloride, that the most practical method of making chlorine monoxide, by dehydration of hypochlorous acid, is not mentioned, and that the use of the term "silicfluorides" is pedantic. But these, after all, are minor faults—it is, perhaps, merely a matter of opinion whether they are faults at all—and they do not detract appreciably from the outstanding merit of the book.

The latter half, or thereabouts, of the book deals with the metals, which are divided, for convenience, into the "typical" metals (Part III) and the "non-typical" (Part IV). In Part III, after a general review of the metallic properties, we pass at once to a discussion of classification and atomic constitution and structure, which is particularly clear and interesting. Thereafter the metals of the alkalis and alkaline earths, beryllium and aluminium, tin and lead, and arsenic, antimony, and bismuth are described. At the end of this part, not at the beginning with the discussion of atomic constitution, there stands in rather curious isolation a table showing the electronic configuration of the elements. One is a little puzzled to know why it should be here, unless it is to be at hand for reference in the discussion, with which Part IV. begins, of the general characteristics of the transition elements. After the remaining metals are disposed of, the book concludes with a short but very good chapter on the radioactive elements.

Because of good, clear type and thin but reasonably opaque paper, the book, despite its thousand pages, is of moderate size and weight and easy to read and handle. It has a good index. As textbooks go, it is expensive, but it is well worth its price. The numerous and well-chosen diagrams of apparatus and plant are particularly clear, and the author's delight in crystals is shown by the many excellent photographs of mineral specimens. In fact, his enthusiasm for one very fine crystal

of fluorite (combined, no doubt, with a momentary lapse of memory) has betrayed him into putting it in twice, as Fig 125 on p 337 and as Fig 235 on p 736

This, in short, is a chemical work of that rare kind which is both scholarly and humane, and as such it may be commended warmly and without reserve to all serious students of the science and to those who may influence their reading

### Physics and Chemistry of the Soil

*The Soil an Introduction to the Scientific Study of the Growth of Crops* By Sir A D Hall Fourth edition, revised and enlarged Pp xvii + 388 (London John Murray, 1931) 9s net

THE reissue of this well-known textbook will be welcomed by all engaged in agricultural teaching. Appearing first in 1903, it had passed through three editions, with many reprints, by 1920, and has now reached a fourth edition. These facts alone indicate plainly the welcome given to the book in the past, and the reason for this is not far to seek. It demands no wide knowledge of the pure sciences on the part of the reader. It accepts the average student of agriculture as his lecturer generally finds him—a man anxious to know something of the fundamental scientific facts underlying his profession but by force of circumstances quite unable to undertake a thorough scientific training before beginning his more technical studies.

As the author stated in his original introduction, the book is “primarily intended for the students of our agricultural colleges and schools, and for the farmer who wishes to know something about the materials he is handling day by day.” This purpose it serves admirably, but its use need not be limited to this type of reader. A teacher might well put it into the hands of the budding agricultural chemist, after his training in pure science, as a general survey of our knowledge of the soil. To such a student its extremely readable character makes it a useful introduction to the more highly specialised publications dealing with particular aspects of the subject.

The new edition follows fairly closely the general lines of previous issues, though a considerable amount of new material has been incorporated. Starting with a description of the soil-forming processes, the author deals successively with the physical and chemical properties of the soil, the soil micro-organisms and the processes dependent on them, the retention of fertilisers, base exchange, the

loss of soil constituents by leeching, soil acidity, causes of fertility and sterility in soils, and, finally, the classification of soils into types. Never losing sight of his original object, the author brings each subject within the grasp of the reader he has in view and illustrates the general principles by an abundance of examples from both scientifically controlled field experiments and farming practice.

It is interesting to note the infiltration of recent advances in soil science into a book of this type. Extensive treatment of such subjects as soil colloids, hydrogen ion concentrations, soil profiles, and the classification of soils founded on the work of the Russian school would obviously have been impossible, but each of these subjects receives mention and finds its place amongst the older material.

A short bibliography, useful to the student as a guide to wider reading, has been added, and its value is enhanced by the care which has been taken in the selection of the items. A short index completes the volume.

As might be expected, the book is excellently produced and is singularly free from errors. The volume in its new form certainly maintains the high position it has made for itself in the past.

H A D NEVILLE

### Fundamentals of Ophthalmology

*Text-Book of Ophthalmology* By Dr W Stewart Duke-Elder Vol 1 *The Development, Form and Function of the Visual Apparatus* Pp xxix + 1124 + 7 plates (London Henry Kimpton, 1932) 63s net

THERE have been several good manuals of ophthalmology written by Englishmen. The first of the modern, that is, post-ophthalmoscopic, period was written by the late Mr Edward Nettleship. It was a very remarkable book, which, like its contemporary, Gowers's “Medical Ophthalmology”, well merits perusal even to-day, for it is packed with the observations of a very great scientific clinician. Doubtless a larger and more comprehensive textbook would have been written in due course if it had not been for the appearance of Fuchs's textbook, which was soon translated into English and is still universally read. The English version was edited and published in America, and has undergone transformations in later editions which are not all improvements. As so often occurs, ill-digested new material has been invaginated into the text in such a manner as to obscure its balance and perspective without making it satisfactorily encyclopædic. The

Germans have published more comprehensive works, such as the gigantic "Graefe-Saemisch" in countless volumes, still unfinished, and likely ever to remain so. More recently, they have issued the first three volumes of a so-called "Kurzes Handbuch", which, when the seven volumes are completed, will cost £49!

The time is therefore ripe for a new textbook, and if the final two volumes are as good as the first, the need will be well satisfied by Duke-Elder. This first volume deals with the anatomical, physiological, and psychological foundations of ophthalmology. It is the most complete and most up-to-date résumé of our knowledge of the subject. The separate sections are devoted to phylogeny, anatomy and comparative anatomy, ontogeny, physiology and biochemistry, optics, the physicochemistry of vision, the physiology of vision (visual sensations), and the psychology of vision (visual perceptions). Though each of these sections demands specialised study and very diverse mental abilities, the author has shown himself well able to surmount each successive obstacle. He possesses an unusual capacity to segregate the salient points from masses of literature, to arrange them in logical order, and to impart some of his own enthusiasm to the reader. For this is no dry-as-dust compilation. He has taken a leaf out of the late Prof. Bayliss's book, and by judicious historical and biographical notes, accompanied by portraits of outstanding workers in the various fields, he has made the book eminently readable and attractive.

The book is also noteworthy in providing a concise account of the author's own valuable contributions to the physiology and biochemistry of the eye. These researches have so important a bearing on general physiology, especially that of lymph formation, that the attention of physiologists should be directed specifically to them. The investigations of Leber, confirmed and extended by Starling and others, proved that it was unnecessary to predicate any true secretory activity to account for most of the facts relating to lymph formation in the eye and the intraocular pressure. These workers propounded a filtration hypothesis, although they were fully conscious of the lacunæ in their knowledge of other biochemical and biophysical factors which undoubtedly play a part. By a masterly application of the methods of modern biochemical technique, Duke-Elder has shown that these factors play indeed the preponderant rôle. By an exhaustive experimental investigation of the hydrostatic conditions and the chemical constitution and physical characters of the intraocular fluid,

he has shown that every factor is consistent with the view that the intraocular fluid is a dialysate in equilibrium with the capillary blood.

Without in any way depreciating the value of these researches, it may be pointed out that no more than the filtration hypothesis do they reach finality. Indeed, to some extent, they introduce fresh difficulties. For example, they throw back the peculiarities of lymph constitution and formation in different organs and different species to differing permeability of the capillaries. "The variation is, of course, a biological adaptation to the needs of the tissue concerned" (p. 428), which savours of a teleological *deus ex machina*. There are also many pathological facts which can scarcely be explained on our present knowledge. None the less, the work is of the first order in scientific insight and technical accomplishment.

The book is beautifully produced and illustrated.

### Short Reviews

*Das periodische System in neuer Anordnung mit Tabellen über Fünfzehn physikalische Konstanten in Anordnung nach der Ordnungszahl der Elemente und nach der Grösse der Konstanten.* Von Dr. Darwin O. Lyon. Zweite Auflage. Pp. vi + 40 + 4 Tafeln + 23 Kurven. (Leipzig und Wien: Franz Deuticke, 1931.) 8 gold marks.

IN attempting a detailed study of the magnetic properties of all the elements, particularly in relation to their relative abundance in the earth's crust, in the hope of being able to throw light upon the process of their evolution, the author of this essay has gone to considerable trouble in drawing up an elaborate set of tables, in which a number of physical constants of the various elements are arranged not only in the order of atomic numbers but also in order of magnitude. The Thomsen-Bohr arrangement of the elements is given in Table 1 for reference. Table 2 contains some new features in the familiar scheme of 18 groups and 8 periods. Thus, instead of atomic weights, the following values are inserted: atomic number, electrical resistance, magnetic susceptibility, density and melting point, whilst dia- and para-magnetic properties are indicated by means of shading. The peculiar character of oxygen, which is strongly paramagnetic in itself, though diamagnetic in many of its compounds, is denoted by striped shading.

Much more useful arrangements will, however, be found in Tables 3 and 4, which form the most notable feature of the work. In Table 3 will be found the following physical constants of the elements, arranged in the order of their atomic numbers: atomic number, atomic weight, density and thermal expansion for both solids and liquids, melting and boiling points, latent heats of fusion and of volatilisation, specific heat, electrical resistance, magnetic susceptibility, entropy, and sound

conductivity, the values for the last-named property being restricted to twenty-four elements. Table 4 contains all these constants, but arranged for each property in strict order of magnitude, and, in addition, certain ratios of these constants are tabulated. The different constants have also been plotted graphically after the manner of Lothar Meyer's well-known graph of atomic volumes.

*The Botany of Crop Plants: a Text and Reference Book.* By Prof. W. W. Robbins. Third edition, revised. Pp. x+639. (Philadelphia: P. Blakiston's Son and Co., Inc., 1931.) 4 dollars.

THE value of this book, first published in 1917, as a classroom textbook is testified by the fact that a third edition is now called for. The undue inflation that is frequently caused by the inclusion of fresh material in repeated editions is here obviated by the elimination of most of the tables and text matter dealing with the distribution and yield of crop plants. The treatment is essentially botanical, not horticultural, and such matters as methods of cultivation and the soils appropriate for various crops do not come within its scope.

The book is prefaced by a short botanical outline, providing a revision of fundamental points necessary for the better understanding of the main discussion. Crops are dealt with according to their families, and the range of data discussed varies according to the type of information which is most useful in each individual case. The practical and economic aspects are kept in view throughout, and the references at the end of each chapter provide useful guidance to those students who desire more detailed knowledge of particular crops. Where necessary, keys are given for the classification of the different genera, species, or varieties. Many of these keys are original, and no attempt is made at uniformity, each case being dealt with on its own merits.

The illustrations deserve a special meed of praise for their clarity, many of them being simplified annotated line drawings, which convey a distinct impression of the special points they are intended to exemplify.

*Polyphase Induction Motors: their Theory, Calculation and Application.* By Louis Lagron. Translated by R. C. Simpson and Dr. M. G. Say. Pp. xiv+218. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1931.) 15s. net.

READERS of this book should have a good knowledge of electromagnetic principles and a working knowledge of the ordinary vector methods of discussing alternating current problems. As the book discusses only polyphase induction motors, its scope is scarcely wide enough for the student, whose library is naturally somewhat limited in size. The reasoning is easy to follow, but it is only mildly interesting to the engineer, as few of the difficulties of the theory are pointed out.

For mining purposes and for work in agriculture these motors are widely used, as they are not easily damaged. They were originally called 'asynchronous motors', but this led to confusion with

'a synchronous motor', and so the phrase 'non-synchronous' motor has come into use. The translators use both terms. The great advantage of an induction machine is that it requires no direct current excitation. If we drive it by means of external power above synchronous speed it becomes a generator. Thus it can be used for braking purposes in lifts and trains and, under certain conditions, power can be returned to the lines. Brief descriptions are given of cascade converters and frequency changers.

*But for the Grace of God.* By J. W. N. Sullivan. Pp. 223. (London: Jonathan Cape, Ltd., 1932.) 7s. 6d. net.

IN earlier works Mr. J. W. N. Sullivan has exercised his literary gifts in making science intelligible to readers who are prepared to give thoughtful attention to novel conceptions and complex relationships. He has been very successful in his mission, and has rendered good service to science by his writings. In the present volume Mr. Sullivan tells the story of his life and reactions—physical and psychological. He intended at one time to present the events and experiences in the form of a novel, but decided eventually to adopt the autobiographical style. The emotional episodes are delicately described, but there is nothing particularly unusual about them even to the men of science who are said to be "exceptionally incomplete as human beings." Many thought-provoking aphorisms are, however, to be found in the book, such, for example, as "The attempt to teach mathematics by making it as 'concrete' as possible is killing to the naturally mathematical intelligence", and "It is the scientific man, not the poet, who is the dweller in dreamland." As a personal revelation of the development of a scientific mind, the book is well worth reading.

*Seventy Years in Archaeology.* By Sir Flinders Petrie. Pp. viii+284+26 plates. (London: Sampson Low, Marston and Co., Ltd., n.d.) 18s. net.

AT least one reader of Sir Flinders Petrie's autobiography must admit to closing the book with a feeling of disappointment. It falls between two stools. The general reader, who is no Egyptologist, will look to its author in the hope of gaining perspective in a review of archaeological discovery in Egypt during the last fifty years, but he will find that the book confines itself strictly within the limitations of its title as a personal record of work in the field year by year since 1880, when Sir Flinders first went to Egypt. The Egyptologist, on the other hand, will regard it as too brief, too summary in its descriptions, to serve as anything more than a reminder of where the author was digging in any given year. From one who is our greatest pioneer and systematiser in archaeological exploration, the most prominent and the most striking figure in British archaeology in the present century, a broader view of his own work and its relation to archaeological studies might legitimately be expected.



## The Land Utilisation Survey of Britain

By Dr. L. DUDLEY STAMP, Director of the Survey

AFTER about a year spent in preliminary experiment, the Land Utilisation Survey of Britain, aided by an initial grant from the Rockefeller Research Foundation administered by the London School of Economics, began work with the appointment of its first organising secretary in October 1930. The genesis of the scheme, its aims and objects, have been explained at some length in papers read before the Royal Geographi-

cal Society<sup>1</sup> and the Royal Scottish Geographical Society.<sup>2</sup> It may be said very simply that the aim of the Survey is to make a cartographical record, complete for the whole of Great Britain and referring to the years 1931 and 1932, of the uses to which the surface of the country is being placed at the present time.

the discretion of the surveyor whether each piece of land is merely marked with the initial letter, as given below, or lightly coloured.

(1) Forest and woodland, marked F; if coloured, a dark green. Forests and woodlands are already marked on the six-inch maps, but it is necessary, especially where the maps are rather out of date, that each area should be checked, and special care is required to include newly planted areas. After

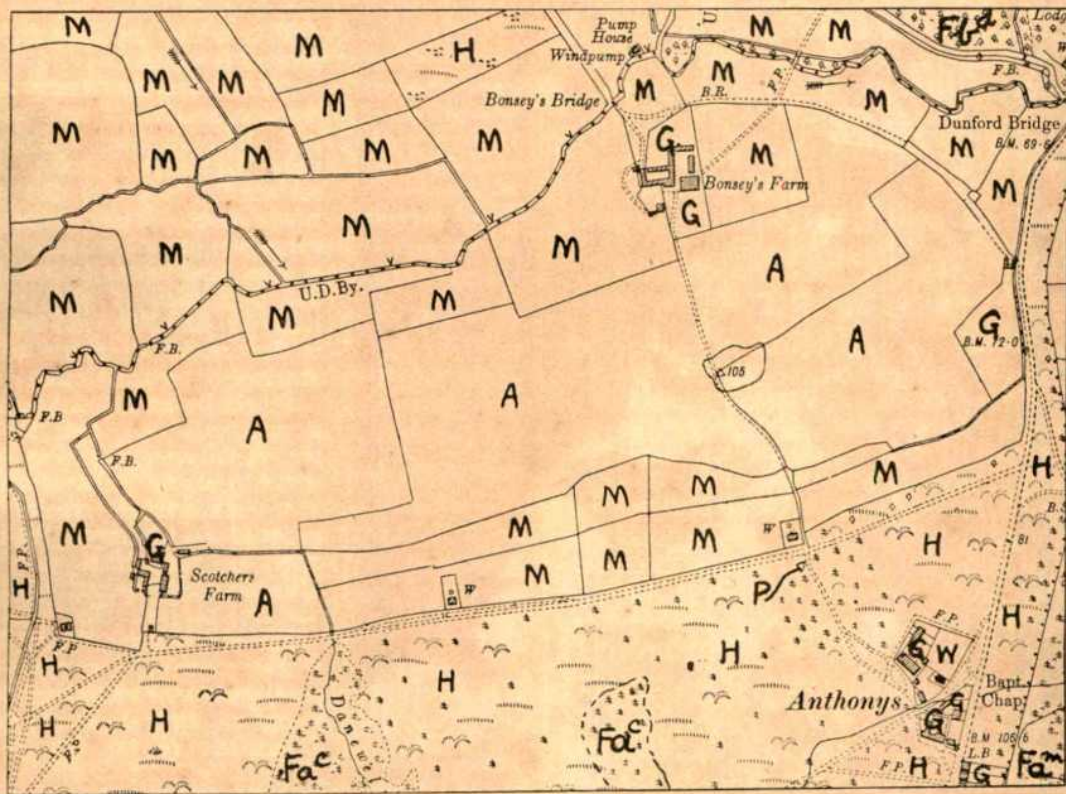


FIG. 1.—Portion of Ordnance Survey map, 6 in. to 1 mile, with lettering inserted by Land Utilisation Survey. (Reproduced by permission.)

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The record is being made on the maps published by the Ordnance Survey on the scale of six inches to the mile, since on these maps every individual field is already marked (Fig. 1). There are the equivalent of about 22,000 quarter-sheets of these maps, each representing six square miles, to be covered for the whole of Britain, and, broadly speaking, each quarter-sheet requires about two days' work. After a number of preliminary experiments, the following simple classification was adopted. It may be mentioned that it was left to

consultation with the Forestry Commission, the following classification of forests was adopted: (a) High forest—big trees sufficiently close for their crowns to touch, and useful for timber production. (b) Coppice, or coppice with standards—woodland that is cut over every few years for fencing, posts, etc. (c) Scrub—small bushes or trees unfit for cutting. (d) Forest felled and not replanted. Thus each piece of forest or woodland has a lettering, Fa, Fb, Fc, and Fd, and it is then also possible to distinguish coniferous, c, deciduous, d, and mixed, m (Fa<sup>d</sup>, etc.).

(2) Meadowland and permanent grass, marked M and coloured light green. It is important that rotation grass should be excluded from this category.

(3) Arable or tilled land, including rotation grass and fallow, marked A and coloured brown.



Some areas of arable land are quite definitely used as market gardens, which are then further distinguished by the letters *MG*, but it was not felt possible to make a separate category for market

marked *G* and coloured light purple. Houses with gardens sufficiently large to grow a few vegetables or even flowers come in this category, because the area, though producing comparatively little, is still productive. Allotments are included in this category since they are merely gardens at a distance from the worker's house. Orchards are usually separately distinguished on the six-inch map, and so the symbol combined with the letter *G* readily distinguishes them; but if the ground is used for grazing, the symbols may be combined *GM*, or where used for fruit and ground crops *GA*.

(6) Land agriculturally unproductive, marked *W* and coloured red. This category includes not only buildings, yards, mines, cemeteries, etc., but also purely waste land. Many enthusiastic surveyors have been able to add a great deal to our knowledge of the utilisation of the countryside by definitely stating what is the actual character of land marked *W* on their maps.

It will be seen that the scheme is a simple one, and for that reason the survey is being carried out very largely by school children, as an educational exercise, in all parts of the country. Indeed, it may be said that the Land Utilisation Survey has two aspects and two objects. The first is the value of the work as an educational exercise, and the whole idea grew originally out of the work of the Regional Survey Committee of the Geographical Association. The more progressive schools throughout the country have for many years been carrying out local regional surveys, and on all hands it was obvious that the training in accurate observation which was entailed and the interest in local environment which was aroused—and invariably led to a remarkable realisation of civic consciousness—afforded an objective in itself. It was only to be regretted that all the rising generation should not be able to share in such an

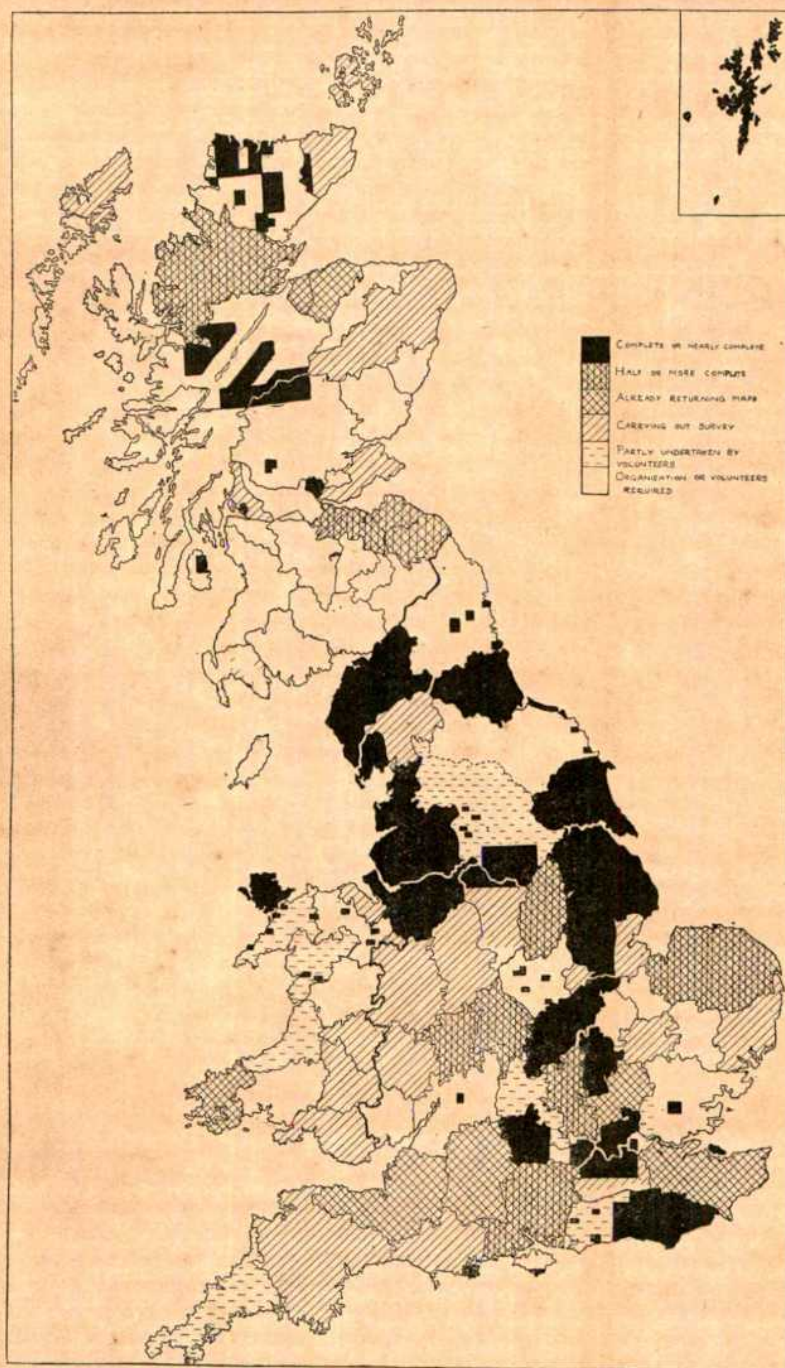


FIG. 2.—State of Land Utilisation Survey of Great Britain to Feb. 18, 1932.

gardens, because numbers of tracts of arable land are only used for market gardening purposes occasionally.

(4) Heathland, moorland, commons, and rough hill pasture, including swamp and marsh pasture. These are marked *H* and coloured yellow.

(5) Gardens, allotments, orchards, and nurseries,

exercise. Hence it was felt that if a nation-wide survey on simple lines could be organised it would heighten the value of existing regional surveys and give a new incentive to those who had not yet undertaken such work, by permitting the participants to realise that they were really doing part of a great nation-wide work.



It may be said at once that the enthusiasm with which the scheme was received by educational authorities almost throughout Great Britain has been remarkable, and about two-thirds of the counties of England and Wales have been organised locally by directors of education. As the accompanying map (Fig. 2) shows, large areas have been completed, and testimony is unanimous as to the educational value of the work.

In the second place, there is the permanent value of such a survey. It must be said at the outset that the Land Utilisation Survey is an entirely independent body and has no connexion with any government department or with any political party, and that the inception of the scheme at a time when land valuation was a subject for Parliamentary discussion was purely accidental. Despite the rapidity with which changes in agricultural practice in Great Britain are taking place—for example, there is now less than half the area under the plough that there was fifty years ago—it is a fact that no record is available as to the exact areas over which the changes are happening. Statistics are available on a county basis and, in manuscript, on a parish basis, but in the absence of cartographical record it is impossible to evaluate the relative importance of the factors which are causing the change in a given locality. In some areas it may be soil, in others climate. It may be elevation or aspect, accessibility, or merely the progressiveness or lack of progressiveness, as the case may be, on the part of the farmer that has determined the changes in local agricultural practice. It is certain that, if a record of this character can be made for the whole of Great Britain, agricultural economists in the future will have an important basis on which to work.

It has been urged that the volunteer observers lack the training with which to make sufficiently accurate observations. To this there are several answers. In the first place, the scheme is a simple one, and on all hands where there are difficult points the advice of the farmers themselves is being sought and given willingly. In the second place, there is a ready check, in that separate sheets

of the six-inch map by different surveyors must fit along the edges where they join, and if there is a disparity in observation, this is at once apparent. In the third place, trained observers are checking the results as they are obtained by making traverses across the sheets.

The map reproduced as Fig. 2 shows the present state of the work. Two things deserve emphasis. First, thanks are due to those who have so nobly assisted up to the present date, when more than four thousand sheets have been completed and returned to the central office, but there are still gaps in the scheme, and in a number of cases the organisation of a whole county is a matter of most urgent necessity. Broadly speaking, it is found that there must be at least one really keen person on the spot for the work to be successful. It is obvious also that any serious delay in the completion of remaining tracts will cause work already done to be vitiated to a considerable extent, for, to be of value, the record should be complete for the years 1931 and 1932. In many of the areas shown on the map as in charge of volunteers there is the need for additional volunteers to fill in remaining tracts. It may be said that the maps are supplied at a reduced rate of 1s 6d each to those volunteers who wish to keep them when completed. They are merely forwarded to the central office and there copied by a photostat process. The maps themselves are retained at the central office if the surveyor does not wish to purchase them.

The Survey's headquarters are at 18 Houghton Street, W.C.2, and are open daily from 10 to 5, and inquiries are welcomed, by letter and in person. The secretary is Mr. E. C. Willatts, and the advisory committee of the Survey includes representatives from the London School of Economics (in the person of Sir William Beveridge), the Ordnance Survey, the Land Agents' Society, the County Councils Association, the Boy Scouts' Association, whilst agriculturists are represented by the director of Rothamsted Experimental Station (Sir John Russell).

<sup>1</sup> *Geographical J.*, 78, July 1931.

<sup>2</sup> *Scottish Geographical Mag.*, 47, May 1931.

### Vortex Motion in Vibrating Columns of Air

ONE of the most familiar and fascinating experiments in acoustics is that initiated by Kundt in 1866, in which the vibrations of an air column enclosed in a glass tube are revealed by means of a fine powder such as cork or lycopodium. Almost everyone is familiar with the manner in which the dust collects in little heaps at the nodes, thereby providing a simple means of estimating the velocity of sound in the gas enclosed in the tube.

An interesting secondary phenomenon also is the formation of a series of ridges or striations of dust lying across the axis of the tube. An attempt to explain this peculiar formation was made in 1891 by W. König. His theory, based on attractions and repulsions between spheres in a vibrating fluid, was universally accepted until the present

time. Even Rayleigh found nothing in it to criticise.

In two papers recently published,\* Prof. E. N. da C. Andrade has thrown fresh light on the subject in a somewhat startling manner. In the older experiments the observations of the striations were always made under static conditions, that is, after the air vibration had ceased, instead of in the dynamic state whilst the air was in vibration. Not only this, but also the method of excitation was not always maintained for a period sufficiently long for the motion to reach a final stable condition, nor was the amplitude of excitation kept uniform. Prof. Andrade remedies all these defects in

\* *Proc. Roy. Soc. A*, 134, pp. 445-470, 1931, and *Phil. Trans. Roy. Soc. A*, 230, pp. 413-445, 1932.

technique by the simple, but very effective, expedient of using a vibrating diaphragm driven by the alternating current from a thermionic valve oscillator of controllable frequency and current output. By such means he has demonstrated that even very small cork dust particles are unsuitable as true indicators of vibratory air motion. Instead of behaving as tracing points they act as obstacles which initiate local vortex motion in the vibrating gas. Consequently, smoke particles are used as a means of studying the true movement of the air in a dust-free tube, suitable precautions (water jackets, etc.) being taken to prevent circulations due to convection currents. A series of beautiful photographs reveals regular circulations of air in the tube, the general drift being from antinode to node along the wall, returning up the centre of the tube. The resonant air column is divided into half wave-lengths by the regular drift-motion of the gas. The form of the stream lines agrees fairly well with Rayleigh's approximate theory.

An entirely novel and most important application of the air vibrations in the resonant tube is made by Prof. Andrade when he utilises the phenomenon to investigate vortex motion around obstacles in the vibrating air. By means of a specially designed tube, and making use of tobacco smoke (from a "cheap cigarette") to indicate the fluid flow, a series of photographs has been taken to show the formation of vortices around objects of simple geometrical form—spheres and cylinders of various diameters. The conditions of formation of the vortices are studied, in particular the critical velocity necessary to initiate vortex motion. In order to determine this velocity it was necessary to measure the actual amplitude of the air vibration, observing the individual smoke particles by means of a microscope. This measurement is in itself a

notable achievement, forming as it does the basis of a standard source of sound. The results obtained for the critical velocity in alternating flow are, considering the difficulty of the experiment, in good agreement with similar measurements by other observers for steady flow.

The second of Prof. Andrade's papers deals more particularly with the general behaviour and grouping of solid particles under the influence of air vibrations in tubes. The phenomena observed, antinodal discs, primary and secondary striations, are shown in a most convincing manner to be due to vortex motion and general circulation set up when the air-particle velocity in the tube exceeds the critical value. König's theory is conclusively proved to be untenable as it entirely ignores such vortex motion. It would require too much space to enter into details of the wonderful arrangements of the irregular particles of cork dust, the spherical particles of carnauba wax and the vortex streams around obstructing particles lying in the tube. Actual photographs of the motion of minute dust particles demonstrate the alternating motion superposed on the general drift.

Acoustics has assuredly taken a new lease of life in recent years. The two papers by Prof. Andrade briefly summarised in the foregoing remarks show in a most striking manner how even an ordinary textbook experiment in sound may be revived to yield most interesting and valuable information. The old Kundt's tube experiment now provides a means not only of measuring sound velocity, but also of producing vibrations of known amplitude (a standard source of sound), and of studying vortex motion. One cannot help wondering, however, how many "cheap cigarettes" Prof. Andrade must have smoked "in the cause of science."

### Neanderthal Man in Palestine

A CABLEGRAM has been received from Mr. Theodore McCown, who, in the temporary absence of Miss Dorothy Garrod, is directing the exploration of caves in Mount Carmel, announcing the discovery of fossil remains of three individuals of the Neanderthal species of mankind. The discovery thus announced is of more than usual importance, it brings to a successful issue a search which has been conducted in Palestine since 1925, first by the British School of Archaeology and latterly by a combined expedition fitted out by that School in conjunction with the American School of Prehistoric Research. Miss Garrod is in charge of the combined expedition, and to her must go the chief credit.

To appreciate the importance of the discovery just announced, it is necessary to recall the sequence of events which have led up to it. The first discovery was made by Mr. Turville Petre in 1925 when excavating a cave on the western shores of Lake Galilee, deep in a Mousterian stratum he found the front part of a skull showing Neanderthal characteristics, but also certain other traits which

raised a suspicion that the Neanderthals of Palestine were racially different from their contemporaries of Europe. In 1928, Miss Garrod, while excavating a cave (Shukbah) on the western flanks of the Judean Hill, penetrated a Mousterian stratum and found a tooth and fragment of skull, which, although undoubtedly Neanderthal in their characterisation, left the racial problem of the ancient Palestiniens unsolved. In 1929, Miss Garrod began the excavation of a vast cave in the Wady-el-Mughara in the western flank of Mount Carmel, and again reached a Mousterian stratum.

Although fossil traces were again found in that year and in the following (1930), they were insufficient to throw light on racial characterisation. In 1931, however, the search was crowned with a partial success. Mr. McCown, a student of the American School of Prehistoric Research—recommended by its director, Prof. MacCurdy—joined Miss Garrod, and was placed in charge of the excavation of an adjacent rock-shelter. In the terrace of this shelter, six feet below its surface and four feet within a Mousterian stratum, he exposed

part of a child's skeleton embedded in hard travertine

The block containing the child was hewn out and sent to the Museum of the Royal College of Surgeons, London, where the encrusting rock was successfully chiselled away from the skeleton by Ernest Smith. The extraction involved three months of delicate manipulation. It was then seen that the child had been buried in a sitting posture, heels under the buttocks, back flexed, and head thrust down on the breast. The child had been about four years of age and a little more than three feet in stature, being of slender build. Unfortunately, the face had been smashed after burial and the teeth were found scattered near the skull. The teeth left no doubt as to the racial nature of the child, they had the characteristic Neanderthalian traits. So, too, had the temporal bones. The frontal bone was damaged, but the hinder part of the skull—the part missing in the Galilee skull—was intact and well preserved.

Mr. McCown joined Sir Arthur Keith in January of the present year to complete an investigation of the anatomical details and draw up a report. The hinder part of the child's head differed altogether in its conformation from any Neanderthal skull so far discovered. The cerebellar lobes were set

widely apart, so that when the skull is viewed from behind there is a pronounced lateral fullness or bulge—as in the skulls of young anthropoid apes. There were also certain features which recalled modern rather than Neanderthal man. It became important to remove from the interior of the skull—its walls are only 3 mm in thickness—the hard mass of rock which filled it. This was successfully done by Mr. McCown and a cast was taken of the interior, and thus an exact reproduction of the shape of the brain was obtained. The position of the cerebellar lobes and of the overlying occipital lobes are quite different from the arrangement of parts seen in any known race of mankind.

It therefore became more than ever important that the adult form of the Neanderthal Palestinians should be discovered. The expedition for the present year was timed to set out at the end of March, but owing to Miss Garrod's illness, Mr. McCown had to return alone to resume the excavation of the rock-shelter at Mount Carmel. The cablegram just received announces his success, and justifies the assumption that he is now in a position to determine the racial characteristics of the Neanderthal Palestinians. The stratum at the rock-shelter represents upper or later Mousterian deposits.

### Obituary

SIR PATRICK GEDDES

SIR PATRICK GEDDES died at the Collège des Écossais, Montpellier, on Sunday, April 17, at seventy-seven years of age, but still as full of ideas and enthusiasms as a young man. He was born in Perth in 1854, the son of Capt. Alexander Geddes, of the Black Watch, and he retained throughout life his feeling for the Highlands and their memories and survivals of the days before industrialism. Inspired by Darwin's work, he came to study under Huxley, but his primary interest was in the application of Darwinian ideas to the problems of human society, and he increasingly turned to the ideas of Lamarck, Herbert Spencer, and Auguste Comte, and realised his kinship of thought with Bergson. His thoughts were turned in this direction partly through a threat of blindness which, while he was carrying out research in Mexico, made microscope work impossible and forced him to live in a darkened room. Like Weismann in similar circumstances, he turned to thought and its graphical expression in highly suggestive notation systems.

In biology, Geddes was deeply concerned with ideas of metabolic tides in the organism, and saw plants, animals, and men as incarnations of vital activity fitting the expression of inner needs and urges into the frame of an outer environment that their activity was ever altering. Applications of this point of view to society led him to become the inspiration of the Sociological Society, the apostle of regional and town planning, the friend and counsellor of Herbertson in his geographical efforts at Oxford, the planner of the University of Jerusalem, a suggestive psychologist, and, above all, an

interpreter quick to seize important points in the thought of other men and to respond with suggestions of relations that they might not have perceived. For, in a generation bent on analysis, he was ever seeking synthesis and pressing it forward with his overwhelming physical and mental vigour touched by mystical idealism. To try to help fellow-workers to maintain freshness, he first developed the idea of summer schools, which have become such a feature of educational and research efforts, he interested himself in exhibitions, and all but carried through a magnificent scheme in connexion with the Paris Exhibition of 1900, spoiled in the end by a political crisis arising out of the Dreyfus case. He struggled to express and exhibit in his 'Outlook Tower' at Edinburgh his ideas of synthesis, and many a worker has found there, despite its poverty of resources and resulting inadequacies, a stimulus that has never been lost. A large collection of maps and illustrations relating to the evolution of cities was sunk, during the War, on a journey to Madras.

The partnership of Patrick Geddes and J. Arthur Thomson was as picturesque as it was valuable to other thinkers. Their 'Evolution of Sex', their little book on 'Evolution' in the Home University Library, and their recent instalment of a large work, were all efforts to express a much-needed point of view. In his other partnership, with Victor Branford, Geddes sought in a series of books and articles to give a synthetic view of social evolution. But publication and matters of personal fame in scientific work were always secondary to the desire to help men to understand their environments and

adjust them in such a way as to meet the need, not for immediate gain so much as for an enduring advance from which future generations might gain enhanced opportunities of expression of the best aspects of their personalities. His civic improvements at Edinburgh, his betterment of Indian cities, his efforts for residential halls for British students in French universities with the view of international understanding, and, perhaps most intimately of all, his gardens, were all the expression of the idealism that was the dominant note in a noble character.

#### DR L. A. BAUER

DR LOUIS AGRICOLA BAUER, who was killed on April 12, by falling from a window of his flat in Washington, was probably the best-known authority on terrestrial magnetism in the world. Born in Cincinnati, on Jan. 26, 1865, he was educated at the university there, and in Berlin. From 1887 until 1892 he was astronomer and magnetic computer in the U.S. Coast and Geodetic Survey, and in 1895-96 was an assistant to Michelson at Chicago. There he founded the journal *Terrestrial Magnetism* (the words *and Atmospheric Electricity* being added to the title in 1898), this was then, and still is, the only periodical expressly devoted to the subject. He conducted the journal for many years on his own financial responsibility, occasionally assisted by grants.

In 1896, Dr. Bauer began a magnetic survey of Maryland, under the State geologist—this was the only State magnetic survey that had been undertaken for many years, he continued the survey during two or three summer vacations, and published a very interesting historical account of terrestrial magnetic observation in his first report on the Survey. In 1897 he became assistant professor of mathematics and mathematical physics at Cincinnati. His enthusiasm for terrestrial magnetism, and his energetic pursuit of magnetic work, aroused renewed interest in the subject in the United States, and in 1899 he rejoined the Coast and Geodetic Survey as chief of the newly founded Division of Terrestrial Magnetism. There he initiated an active policy, planning a magnetic survey of the whole of the United States and its territories elsewhere, and, in connexion therewith, instituting four new magnetic observatories, at Cheltenham in Maryland, Baldwin in Kansas, Sitka in Alaska, and Honolulu in Hawaii. He also greatly developed the magnetic work of the ships of the Coast and Geodetic Survey. Though he did not long remain in his new office, his influence on the work of the Coast and Geodetic Survey has been lasting, and the Survey is now one of the most active national organisations undertaking magnetic observatory and survey work.

Bauer's ambitions for his chosen science did not stop short at national frontiers, however, he saw that the science needed a world magnetic survey, and that, on account of the irregular and incalculable course of the secular variation, this survey must be renewed every generation, unless important

data are to be for ever lost. He saw also that this could not be achieved by national organisations, so many countries being scientifically backward, while many parts of the oceans had long remained unsurveyed. He therefore drew up a plan for a research department of terrestrial magnetism, which should fill up what was lacking in the efforts made by other magnetic organisations, as regards the world survey, and also do everything possible in other ways to advance the science. His plans led to the formation of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, in 1904, he became the first director, and held the office until he retired through ill-health, in 1930. Under his energetic direction, and with the aid of a devoted staff that he gathered round him, the Department has done a great work for terrestrial magnetism and atmospheric electricity. Perhaps its most important work was done by its two survey ships, first the *Galilee*, and later the non-magnetic ship *Carnegie* (unhappily destroyed, with the loss of its commander, Capt. Ault, in 1929, at Apia, Samoa). Much land magnetic surveying was also done, either directly or by aid given to other bodies. Later the Department instituted two magnetic observatories, at Watheroo in Western Australia and Huancayo in Peru, to mitigate the pressing need for more magnetic observatories in the southern hemisphere. A valuable feature of the ocean survey work was the promptness of publication of the results, which enabled the various national ocean magnetic charts to be greatly improved in many respects. In many other directions also the Department carried out important work, which is still continuing and developing.

In his attempts to elucidate the theoretical aspects of the science Bauer was less successful, but it is well known that the subject is a particularly intractable one. His organising work, and its valuable and permanent results, will assure him a lasting and distinguished place in the roll of benefactors to the science, and his services to it were widely recognised in his lifetime, particularly by his election, in 1927, to the presidency of the international organisation for terrestrial magnetism, under the International Union for Geodesy and Geophysics.

S. C.

WE regret to announce the following deaths

Mr B. A. Behrend, consulting engineer to the Westinghouse Electric and Manufacturing Co., Boston, Mass., a distinguished American engineer interested particularly in alternating current phenomena, on March 25, aged fifty-six years.

Sir David Drummond, C.B.E., eminent professor of medicine at the University of Durham College of Medicine, past president of the British Medical Association, a well-known specialist in diseases of the brain, on April 27, aged seventy-nine years.

Dr Victoria Hazlitt, lecturer in psychology, Bedford College, University of London, for some years secretary of the Committee for Research in Education of the British Psychological Society, on April 19.



## News and Views

## Oldoway Man

IN the correspondence columns of the present issue (p. 721) Dr L S B Leakey replies to the criticisms of the conclusions at which he himself and his colleagues have arrived as to the antiquity of the remains of *Homo sapiens* from the Oldoway beds in East Africa. In effect, he agrees with Messrs Forster Cooper and Watson that it is unlikely that the Oldoway skeleton would have been found in a state of complete articulation and in its contracted position had it been deposited by natural means in the situation in which it was found. It will be remembered that others have felt this a difficulty, notably a writer in *L'Anthropologie*, to whose comment we have already directed attention on a previous occasion (see NATURE, April 23, p. 607). Dr Leakey, however, now states that he personally is of the belief that the position of the skeleton is due to burial, but a burial contemporary with and not subsequent to the deposition of Bed No. 2, in which it was found, Bed No. 3 being laid down after the burial had taken place. The complete absence of any trace of intermixture of the yellow deposits of Bed No. 2 and of the red deposits of Bed No. 3, of which Dr Leakey has assured himself by a personal inspection of the actual skeleton, is conclusive. In the event of an ancient burial, such an admixture would be practically inevitable, while of the two alternatives, an ancient and a modern burial, the geological evidence, as interpreted, appears to point beyond question to the former. Strong corroboration is afforded by the fresh evidence now adduced from the fossil beds of the Kavirondo Gulf, where the old Lake beds have yielded Dr Leakey a fauna and a culture sequence similar to Oldoway, but a fragment of human mandible from Kanam carries back *Homo sapiens* to Pre-Chellian, a stage further removed than Oldoway man.

## Physical Research in the University of Melbourne

PROF T H LABY, professor of natural philosophy in the University of Melbourne, is building up an active school of research in the University. He has at the moment eighteen research workers, one-third of whom are full-time workers. Problems in X-rays, heat, and in the propagation of electromagnetic waves are being investigated. Rowland's method of the coincidence in different orders of spectral lines is being applied to the determination of X-ray wave-lengths in terms of wave-lengths in the ultra-violet determined by interferometer methods. A vacuum spectrograph with a Lyle-Merfield grating in which the incident rays make a glancing angle of  $5^\circ$  has been constructed. This work has been delayed by Prof. Laby's recent illness, but tests already made show that the spectrometer is a convenient one, and that a considerable increase in the accuracy of wave-length determinations below 2200 Å, including X-ray wave-lengths, will be possible. Experiments on the reflection of X-rays are being continued. Incidental to them it has been found that the K-radiation of

carbon ( $\lambda = 45 \text{ Å}$ ) can be excited in an X-ray tube without any evidence being found of the presence of accompanying continuous radiation.

IN addition to the work on spectral physics, which alone might be considered sufficient to occupy the attention of a research school, Prof Laby and his collaborators have undertaken investigations on thermal conductivities and the propagation of electromagnetic waves. In view of the uncertainty as to the true value of the thermal conductivities of air and other gases, of their variation with temperature, and similarly of the thermal conductivities of highly purified metals and their temperature variations—our knowledge of the latter seems very indefinite, although there are many theories to account for the supposed facts—experiments to remove some of these uncertainties are being carried out by Hercus, Kannulnik, and others. In the propagation of electromagnetic waves, Martin and Cherry have found evidence that a laterally deviated wave is an important contributory factor to fading. Munro, Huxley, and Higgs, by means of cathode ray direction finders situated at Melbourne and Canberra, have confirmed that atmospherics have their origin in thunderstorms, no other source having been definitely found. The cathode ray direction finder would appear to have considerable value to meteorology and aviation in Australia.

## Huxley Memorial Lecture

MR ALDOUS HUXLEY gave the Huxley Memorial Lecture at the Imperial College of Science on May 4 and took as his subject "T H Huxley as a Man of Letters". The lecture, which is published as a pamphlet by Messrs Macmillan and Co., Ltd., price 1s net, was a careful, thoroughly sound, and highly stimulating treatment of the subject. Mr. Huxley based his account mainly on what his grandfather had said himself about his own methods and ideals in writing, and followed this up by analysing in detail several typical specimens of Huxley's writing. It was well worth doing, and sent one back with increased pleasure to the reading of other passages of that incomparable scientific master of good English. He is everywhere vigorous, true, and terse, and it is useful, though not surprising, to learn from what Mr. Aldous Huxley tells us, that the excellent finished product was not only the result of a clear and able mind but also of long, determined, and painful practice. Huxley talked about it in some detail to several correspondents, telling Hooker in 1860 how he found it constantly more and more difficult to finish things satisfactorily (which meant that his standard was always becoming higher), and apologising to Varigny, his French translator, for the condensed and idiomatic English, "which must present many difficulties to a translator". "Sometimes", he says, "I write an essay half a dozen times before I get it into the proper shape. But"—and here was one of the great secrets of his success—"the fact is that I have a great love and

respect for my native tongue and take great pains to use it properly."

#### Scientific Writings as Literature

WE should, in fact, be inclined to lay the greater stress on Huxley's native taste and effort and on the favourable circumstances of his writings, and less on the detailed features which Mr Aldous Huxley discovers—the balance of phrases, the *cæsura* ending, the Biblical allusions, and so forth. These are by the way. The main thing was having clear ideas and trying always to say them in the fewest and most appropriate words. The true man of science has in this respect an initial advantage over other writers, because he starts with a definite statement about something observed which he wishes to convey to his readers in the most direct and effective way. German writers do not conform to the rule owing to the complication of their tongue, but recently some professors of English in an American university compiled an anthology of extracts from the writings of men of science as a textbook for students in English. Plenty of names will occur to one at once of scientific writers who might be named in the same class as Huxley, though none perhaps so racy and pointed. His own contemporary Tyndall was one of the best. It should also be remembered that these men were living and writing at a time when a great new idea was in the air and inspiring both those who promoted it and those who were on the defensive to special mental gymnastics. No one can read Huxley without enjoying the bracing atmosphere of controversy in which he worked. He was always stripped and putting the last ounce into his fencing. For this both he and we have largely to thank the doctrine of evolution. We are not so controversial at the present day, or at any rate our controversies have not the same all-pervading and stimulating effect.

#### Manson Medal for Tropical Medical Research

THE Manson medal for tropical medical research, given triennially by the Royal Society of Tropical Medicine and Hygiene, has this year been awarded to Dr. Theobald Smith. In association with Kilborne in 1893, Theobald Smith showed that red-water fever in cattle is transmitted by ticks, and at the same time demonstrated the passage of infection through the ova of one generation of ticks to the next. This discovery proved that a protozoal parasite of mammals could be disseminated by the bite of a blood-sucking arthropod. Probably because Theobald Smith was dealing with a cattle rather than a human disease, this great event in the history of medicine received scant recognition, though it preceded the better-known work of Bruce on the transmission of sleeping sickness and that of Ross on malaria. Indeed, Theobald Smith was the first to transfer the insect transmission theory of protozoal disease from the realms of hypothesis to those of established fact. In 1904, Theobald Smith reported anaphylactic symptoms in dogs and rabbits, and, in a letter to Ehrlich, wrote the original description of the classical anaphylactic shock in guinea-pigs often known as the Theobald Smith phenomenon. In 1907 he proved that it was possible to immunise

guinea-pigs actively by the injections of a balanced mixture of diphtheria toxin and antitoxin, and two years later suggested further investigations of the method with the view of its ultimate application to human beings, thus anticipating Von Behring and Park's work by several years. The previous recipients of the Manson medal have been Sir David Bruce (1933), Senator Ettore Machiavava (1926), and Sir Ronald Ross (1929).

#### Gravitation and Electrodynamics

IN the last of his Rhodes lectures delivered at Oxford a year ago, Prof. A. Einstein pointed out that a defect in the original form of the general theory of relativity was that the electromagnetic field was not expressed by means of the metric of the space-time continuum as was gravitation. By introducing a modified form of the Riemann geometry admitting of distant parallelism, Prof. Einstein obtained field equations which he hoped would remedy this defect. From his Rouse Ball lecture at Cambridge on May 5, it appears that this method of approach has been unsuccessful. Prof. Einstein has reverted to a mathematical technique introduced by Kaluza, and has succeeded in defining a vector with four or five components in space of one less dimension. Introducing parallel displacement, a five-component vector is projected repeatedly on to a four-dimensional plane, giving rise to a curve, the properties of which provide the relationship required. In this way the extra term required to account for the phenomena of electrodynamics is obtained. The method resembles that used in building up the general theory of relativity.

#### Twenty-one Years of Radio Communication

WE congratulate the *Wireless World* on the completion of its twenty-first birthday, which is commemorated in the issue of April 27. For its first two years, the journal was known as the *Marconigraph*, but as the number of amateur enthusiasts was rapidly increasing, it changed its title to the more comprehensive one of the *Wireless World*. So far back as 1914, we find from its pages that the late Mr Campbell Swinton practically predicted the ultimate possibilities of wireless and indicated that at no distant future we would have broadcasting. The War gave a great impetus to the development of radio. After the War, the *Wireless World* took a leading part in the movement for granting amateur licenses and in encouraging the 'Dutch concerts' and the transmissions from Writtle—the forerunners of wireless telephony and broadcasting. It organised communication tests between amateurs in Great Britain and America with the object of finding out whether it would be possible to bridge the Atlantic on short waves. The success of these tests led to intensive research and the discovery that these waves were ideal for distant communication. It also played a foremost part in connexion with Empire broadcasting, and helped to overcome the bitter opposition to the scheme which lasted for several years. The progress made by radio communication during the last twenty-one years is marvellous. There seems no reason to doubt that equally rapid progress will be made for

many years to come. Methods of communication which twenty-one years ago stretched our imagination to the utmost are now commonplace practice. We congratulate Mr H S Pocock, the editor, on the excellent work he has done.

#### University of the Witwatersrand Library

LAST Christmas Eve, a fire took place in the main block of the University of the Witwatersrand. As a result, very considerable damage was done. The main Library was completely destroyed, as were also the priceless Gubbins collection and the Law Library, which are, naturally, irreplaceable. Through the co-operation of the British Association and of other bodies, many replacements of lost and damaged books have been made, but in order to broaden the basis of the appeal, a meeting was held on May 9, in the council room of the Royal Empire Society, presided over by the Earl of Athlone, himself an honorary graduate of the University, the degree of LL D having been conferred upon him when he was the Governor-General of the Union of South Africa, during the visit of the British Association to Johannesburg in 1929. In the course of his introductory remarks, Lord Athlone traced the development of university education in South Africa, and pointed out that the University of the Witwatersrand only received its charter of incorporation ten years ago. In 1925, H R H the Prince of Wales formally opened the new buildings, which occupy a magnificent site on the outskirts of the city. General Smuts was the first honorary graduate. The progress made has been remarkable, and there are now about two thousand students taking the regular courses. It was therefore a tragedy that the 'soul' of the University had been destroyed through the fire.

As a result of the meeting, which was addressed by Dr W Cullen, Mr J G Gubbins, Prof. A P Newton, Sir Frank Heath, and others, a strong and representative committee, upon which Lord Athlone consented to serve, was formed to co-ordinate British efforts for restoring the library of the University. The loss includes the collection of manuscripts, books, and prints presented by Mr Gubbins, the Hoernlé anthropological collection, in addition to all scientific journals and the departmental libraries of classics, English, Afrikaans, German, French, history, mathematics, geography, economics, and education. If the appeal for funds is successful, it is proposed to build a fireproof library, as a separate building, at an estimated cost of £60,000, a large part of which will probably be raised from people who live, or have lived, in South Africa. The chief task of the appeal committee will be, therefore, to procure books and other works to restock the library. It is, of course, impossible to replace the original documents destroyed by the fire, but it is hoped that other collections of a like kind will be forthcoming as the needs of the new library become known and the opportunity which it affords of representing every phase of South African life and culture is realised. Gifts of sets of journals and works of reference will also be gratefully accepted. All communications relating to such gifts should be sent to Dr W Cullen, 4 Broad Street Place, London, E C 2.

#### Plastic Deformation of Metals

DR. F KÖRBER, director of the Kaiser Wilhelm-Institut für Eisenforschung, Düsseldorf, delivered the twenty-second annual May lecture of the Institute of Metals in London on May 11, on "The Plastic Deformation of Metals". Basing his remarks on the results of a series of investigations conducted at Düsseldorf during recent years, Dr Körber dealt with the stress relationships and also with the course of the flow of the material during the most important of the mechanical shaping processes. Discussions were entered into on the conditions requisite for the commencement of plastic flow and also on the possibility of drawing conclusions from the resulting flow phenomena as to the distribution of stress in the material at the inception of deformation. The disturbances in the material in consequence of the more marked deformations in drawing, extrusion, and rolling were traced by a suitable method of investigation. The results were compared with the deformation structures obtained by X-ray methods. The knowledge of the deformation processes so obtained enabled conclusions to be drawn as to the energy or power used in the shaping operations. An exact analysis of the course of deformation in the transition zone led to estimates of the internal losses during the alterations in form. Quantitative treatment of the stress relationships which occurred in the zone of deformation is possible in so far as the pressure created at the surface of contact between the tool and the material is known by actual measurements. From the results of determinations along the roll-gap of the pressure between the rolls and the stock being rolled, a complete quantitative presentation of the distribution of stress in the transition zone between the rolls has been formulated.

#### Electrification of Ulster

IN the *Asea Journal* for February an account is given of the electricity distribution scheme in Northern Ireland. The Irish Free State has built a large water power station on the River Shannon, on the west coast. In Northern Ireland (Ulster), there is also a considerable amount of water power available in the River Bann, which drains a large area round Lough Neagh. A scheme was recently under consideration to build a water power station on this river, but as the question is intimately connected with a land drainage scheme to be carried out by the Government, this scheme has been temporarily suspended. A steam power station has been built in Larne, on the east coast, not far from Belfast. From this station, a 33-kilovolt main transmission line has been taken over the country, through the towns of Ballyclare and Ballymena, with the view of future connexion with the River Bann. The steam power station at Larne has two turbo sets, each of 1750-kilowatt output, and a space has been reserved for one of double the size. In this way the load will be built up gradually, so that when the water power station with its comparatively high initial cost is completed, it will be possible to load it profitably from the start. The electric power will be mainly used by the linen industry, which has long flourished in Ireland. There are also paper mills and cement works in the

district, and numerous small townships. A local company in Larne owns the power station and a Belfast company the overhead distribution system.

#### Atmospheric Effects and the Andean Eruptions

WHEN a solar halo and sun pillar were observed in London a few days after the recent volcanic outbreaks in the Andes, the question of a connexion between the two phenomena was raised. There was no serious case to be made out for any such connexion, in view of the enormous distance that separates Great Britain from the scene of the eruption, and the incredible wind velocity that would have been necessary to bring volcanic dust in such a short time. Moreover, optical phenomena of this kind are known to be due to ice crystals at great heights and not to dust. The more rational question of ultimate meteorological effects in the northern hemisphere is discussed in a recent bulletin from Science Service, Washington, D C. We are reminded that after the explosion of the East Indian volcano Krakatoa in 1883, volcanic dust drifted entirely round the earth, and that the remarkable red sunsets that occurred for several years after can reasonably be attributed to the presence of this dust, for the selective absorption effects of dust upon the constituent colours of the light of the sun is proved at almost every fine sunset in industrial regions. Prof. W. J. Humphreys, of the U.S.A. Weather Bureau, has expressed the opinion that it is only on the supposition that the ash has ascended in large quantities above the level of the highest clouds that it may be expected to cross over to the northern hemisphere, if confined to lower layers, it may perform long journeys in the atmospheric circulation of the southern hemisphere but will tend to be entangled by condensing cloud particles and be brought to the earth by rain. Apart from sunset effects, the probable influence of dust at very high levels upon the weather through weakening of the solar radiation is difficult to estimate, owing to the complexity of the reactions likely to be set up.

#### Funerary Offerings from Ancient Mexico

A tomb deposit described as second only in intrinsic value to the recently discovered treasure of Monte Alban, we learn from a recent Science Service bulletin, has been discovered at Texmelincan, in the State of Guerrero, one hundred and twenty miles south of Mexico City. The tomb is situated in an area covered with mounds concealing buildings and other remains. The objects in the tomb have now been deposited in the Department of Archaeology, Mexico City. Among them the most notable is a disc of gold, eight inches in diameter, with a hole in the centre. On it are engraved two of the characteristic feathered serpents, intertwined, and with the head of an armed warrior protruding from the jaws of each. Two belts, two feet long and three inches wide, are covered with a thin sheeting of beaten gold. There were also found large gold ear-rings, a necklace of thirty-two hollow gold beads and one of seventy-one unusually fine carved jade beads, three necklaces of shell and stone beads, copper bells, and obsidian ear-rings painted red. Some finely polished pottery vessels suggest a Toltec

origin. The nearest important city site, it is pointed out, is Xochicalco, which is noted for its 'Toltec Maya' style.

#### The Rebuilding of Napier and Hastings

The New Zealand correspondent of the *Times*, in the issue for May 5, has given an interesting account of the rebuilding and repair of the towns damaged by the Hawkes Bay earthquake of Feb. 3, 1931. The total loss was estimated at about six million pounds. One-quarter of this amount was provided by the Government, and public subscriptions added nearly £350,000. In Napier, nearly the whole of the business quarter was destroyed. The work of reconstruction includes the widening and replanning of many streets, the laying down of about 20 miles of main sewers, and the provision of new artesian wells or the repair of old ones sufficient to give a supply of four million gallons daily. An unexpected gain from the earthquake is an extensive area of new land. Before the earthquake, plans had been made to reclaim certain shallow parts of the harbour. This work is now unnecessary, as the earthquake raised the level of the land by five or six feet. About 7000 acres of the new land, it is proposed, will be converted into farming land, and the long marine parade will be widened and beautified.

#### Announcements

SIR ARTHUR KEITH will deliver the Stephen Paget memorial lecture at the annual general meeting of the Research Defence Society, which is to be held on Wednesday, June 15, at 3 P.M., in the lecture hall of the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

APPLICATIONS for grants from the Research Fund of the Chemical Society must be made by June 1 on a special form obtainable from the Assistant Secretary, Chemical Society, Burlington House, W.1. Attention is directed to the fact that the income derived from the donation of the Goldsmiths Company is more or less especially devoted to research in inorganic and metallurgical chemistry, and that from the Perkin Memorial Fund to investigations relating to problems connected with the coal-tar and allied industries.

At the annual general meeting of the Challenger Society held on April 27, a resolution to the following effect was carried unanimously. "That a sum of money, provisionally put at £25, to be modified at the discretion of the Committee, should be devoted to the assistance of a desirable student (or students) to enable him (or them) to work at Plymouth (or other Marine Biological Station). Preference to be given to members of the Society, and the selection to be in the hands of the Committee."

THE following appointments have recently been made by the Secretary of State for the Colonies in the Colonial agricultural and forest services. Mr. E. Ballard, to be Government entomologist, Palestine; Mr. E. D. Hill and Mr. W. R. Hudson, inspectors of plants and produce, Gold Coast, to be senior inspectors, Mr. R. R. Staples, agricultural economist, Tanganyika Territory, to be pasture research officer,

Tanganyika Territory, Mr C. G. Trapnell, to be ecologist, Northern Rhodesia, Mr. H. E. Desch, formerly assistant conservator of forests, Nigeria, to be forest research officer (wood technologist), Federated Malay States.

THE Council of the Institution of Civil Engineers has made the following awards in respect of papers read and discussed at the ordinary meetings during session 1931-32. Telford Gold Medals to Dr C. F. Jenkin, emeritus professor of engineering science in the University of Oxford, and to Sir Bernard D'O Darley, of Bahawalpur, India; Stephenson Gold Medal to Mr B. G. White (London), a Telford premium jointly to Mr H. C. Whitehead (Birmingham) and Mr F. R. O'Shaughnessy (Birmingham); Telford premiums to Mr Raymond Carpmal (London), Mr. H. J. Deane (London), Mr John Goodman (Skipton), a Manby premium jointly to Mr W. F. Stanton (Bishops Castle) and Mr A. G. Le Clercq (Walton-on-Thames), a Trevithick premium to Mr. W. C. Ash (Vizagapatam, India).

THE Council of the Institution of Electrical Engineers has made the following awards of premiums for papers read during the session 1931-32, or accepted for publication. Institution premium to Mr. J. Bruce, Ayrton premium to Mr F. Lydall, Fahie premium to Messrs H. Kingsbury and R. A. Goodman, John Hopkinson premium to Mr H. W. Clothier; Kelvin premium to Prof W. M. Thornton and Dr W. G. Thompson, Paris premium to Messrs E. W. Dickinson and H. W. Grummitt, extra premiums to Messrs H. Blades and A. C. MacQueen, Messrs R. O. Kapp and C. G. Carrothers, Dr F. Luschen, Messrs H. Pearce and T. T. Evans, Mr E. A. Watson, Major E. H. E. Woodward, and Mr W. A. Carne. Wireless Section premiums. Duddell premium to Mr T. L. Eckersley, extra premiums to Mr B. S. Gossling, Messrs J. A. Ratchiffe, L. G. Vedy and A. F. Wilkins. Meter and Instrument Section premiums. Silvanus Thompson premium to Prof J. T. MacGregor-Morris and Mr H. Wright, an extra premium to Mr S. H. C. Morton.

Two awards of the Gold Medal of the Institution of Mining and Metallurgy, the highest distinction in its power to confer, have been made by the Council: (a) Sir Harold Carpenter, in recognition of his eminent services in the advancement of metallurgical science and technology; (b) Dr Thomas A. Rickard, in recognition of his services in the general advancement of mining engineering, with special reference to his contributions to technical and historical literature. The following awards have also been made. The Consolidated Gold Fields of South Africa, Ltd., Gold Medal to Mr P. J. Crowle for his investigations on ground movement and methods of support in deep mines (Kolar Gold Fields), The Consolidated Gold Fields of South Africa, Ltd., premium of forty guineas to Prof Bernard W. Holman for his work on flotation reagents, the William Frecheville Student's Prize of ten guineas to Mr Gilbert F. Hatch for his paper on "Check Sampling of Diamond Drill Holes at the Trepcia Mines, Jugoslavia".

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THE office of the High Commissioner for India, India House, Aldwych, is about to publish, in two volumes, "A Manual on the Commercial Timbers of British India", by R. S. Pearson and Prof. H. P. Brown. Descriptions will be given of each family and genus, while under species each timber will be dealt with in detail, commencing with nomenclature and references and followed in order by information on distribution, supplies, a full description of the structure of the timber, mechanical and seasoning properties, durability, working qualities, and present and prospective uses.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.—A headmaster of the Junior Technical School, Stoke-on-Trent.—The Director of Education, Education Offices, Town Hall, Hanley, Stoke-on-Trent (May 16). A lecturer in the Department of Commerce of the Leicester College of Technology.—The Registrar, College of Technology, Leicester (May 18). A head of the Junior Day Technical (Engineering) School of Handsworth Technical College.—The Chief Education Officer, Higher Education Department, Education Office, Margaret Street, Birmingham (May 23). A demonstrator of physiology at the London (Royal Free Hospital) School of Medicine for Women.—The Warden and Secretary, 8 Hunter Street, W.C.1 (May 25). A head of the Chemistry Department and a lecturer in physics and subsidiary chemistry at the Kingston-upon-Hull Municipal Technical College.—The Director of Education, Education Offices, Guildhall, Hull (May 28). A lecturer in mechanical engineering at Armstrong College.—The Registrar, Armstrong College, Newcastle-upon-Tyne (May 28). A lecturer in mechanical engineering at the Camborne Technical School.—The Principal, Technical School, Camborne (May 31). A Morna Macleod research student in biochemistry at the Lister Institute of Preventive Medicine.—The Secretary, Lister Institute, Chelsea Bridge Road, S.W.1 (June 1). A resident assistant pathologist at the Royal Free Hospital and London (R.F.H.) School of Medicine for Women.—The Secretary, Royal Free Hospital, London, W.C.1, or The Warden and Secretary, London (R.F.H.) School of Medicine for Women, W.C.1 (June 3). A Charles Murchison Scholar in clinical medicine at the Royal College of Physicians of London.—The Registrar, College of Physicians, Pall Mall East, S.W.1 (June 4). A Geoffrey Duveen Travelling Student for research in oto-rhino-laryngology in the University of London.—The Academic Registrar, University of London, South Kensington, S.W.7 (June 11). A cotton research botanist in the Bombay Presidency, for the co-ordination of cotton research work in progress in the presidency, and a cotton research botanist in the Punjab, for research with the view to making improvements in local and American cotton.—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (July 16). An assistant lecturer at the University College of the South West of England for work mainly in the teaching of biology in the Education Department.—The Registrar, University College, Exeter.

## Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

### Photochemistry of Vitamins A, B, C, D

THE photochemistry of the vitamins has been studied with the help of a large quartz monochromator. The solutions to be irradiated were enclosed between quartz windows in a rectangular slot cut in a small brass block. The section of the cell corresponded with the dimensions of the rectangular image formed by the curved slit of the monochromator, so that the whole of the solution was irradiated. The cell was filled and emptied with a hypodermic syringe, and was arranged so that the solutions could be handled in the absence of oxygen. Stirring was effected by two steel shot operated by a magnet.

The procedure was to study the absorption spectrum of the substance, and then to irradiate it with an intense beam of light of similar wave-length to that of an absorption band selected after consideration of the spectroscopic data. This procedure usually destroyed the electronic system producing the band, and often led to the development of new bands. When applied to a suitable pre-vitamin, monochromatic irradiation with light of the correct wave-length produces maximum yields of the vitamin, on the other hand, when the destruction by irradiation of the biological activity of a vitamin is effected by the elimination of an absorption band, the activity can be linked up conclusively with the presence of the band. The principal results obtained up to the present are set out below.

**Vitamin A**—The absorption spectrum of  $\beta$ -carotene (supplied by Dr Thomas Moore of the Nutrition Laboratory) was found to contain a weak band at 2700 Å, in addition to the well-known bands in the visible. Since this band was thought to be of peculiar importance, a solution of carotene in cyclohexane was irradiated in an atmosphere of nitrogen by the mercury line 2650. After a few hours, a strong band appeared at a wave-length corresponding closely with that of the band at 3280, which is already widely recognised as characteristic of vitamin A. Further, the solution gave a blue coloration with antimony trichloride in chloroform. Biological experiments, which will occupy perhaps a month, have already been begun in order to determine the activity of the irradiated solution. If the results of these experiments are in harmony with the spectroscopic evidence, it will appear that a photochemical transformation of carotene into vitamin A has been effected.

The destruction of vitamin A has been effected by irradiation with light of wave-length 3130, whereby the characteristic band at 3280 was eliminated in the course of a few hours.

**Vitamin B<sub>1</sub>**—A specimen of vitamin B<sub>1</sub>, prepared by Jansen and Donath and supplied to us by Mr. Birch of the Nutrition Laboratory, showed three absorption bands at 2600, 2400, and 2100. Irradiation by the mercury line 2537 greatly reduced the intensity of the band at 2600, and destroyed the B<sub>1</sub> activity of the sample, as tested by Mr. Birch's observations of the heart-beats of rats. A specimen of the vitamin which had been deactivated by heating with alkali showed a similar absorption spectrum, in which the band of longest wave-length was again missing. The correlation of the 2600 band with the activity of vitamin B<sub>1</sub> has thus been fully established.

**Vitamin C**—We have not yet been able to examine the absorption spectrum of vitamin C, but have found a strong band (which is affected but little by irradiation) at 2650 Å in hexuronic acid, which Szent-Gyorgyi<sup>1</sup> has identified with this vitamin. We have also examined the absorption spectrum of narcotine, which, according to Rygh, is converted into vitamin C by irradiation. In our experiments, no change in the spectrum was produced by irradiation with light corresponding with the wave-length of the bands at 3000 and 2850 Å, but irradiation with light covering the band at 2400 produced a complete change in the spectrum, which after irradiation consisted of a single band at 2900 Å. A comparison of the spectrum of a concentrate of vitamin C with those of hexuronic acid and of narcotine, before and after irradiation, should go far towards settling the problem of identifying the vitamin with these substances.

**Vitamin D**—The conversion of ergosterol into calciferol by irradiation is rendered difficult by the overlapping of their absorption bands, since the five narrow bands of ergosterol are almost covered by a wide calciferol band of shorter wave-length. The wave-length of the mercury line at 3130 was found to

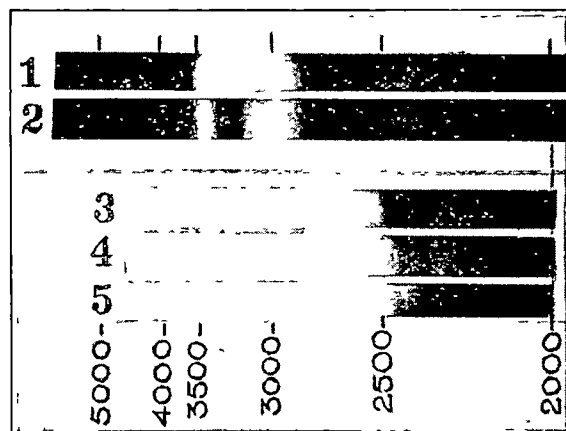


FIG. 1.—Spectra of vitamins (positive, showing dark absorption bands)  
1 Carotene 2 Carotene after irradiation with  $\lambda$ 2537 3 Vitamin B<sub>1</sub> 4 Vitamin B<sub>1</sub> after irradiation with  $\lambda$ 2537 5 Vitamin B<sub>1</sub> after heating with alkali

be too long to convert ergosterol into calciferol even after irradiating for several hours in the absence of oxygen, but the 2967 line, which corresponds approximately with the longest wave-length of the ergosterol bands, produced a strong absorption in the calciferol region after only two hours' irradiation. On the other hand, calciferol was destroyed completely by irradiation for one hour with the mercury lines at 2650 or 2537, with a very slow destruction (which may be attributed to the great width of the calciferol band) when irradiated by the line at 3130. A maximum yield of calciferol is therefore to be expected when light of wave-lengths less than about 2800 is cut out, in agreement with the methods of Reerink and van Wijk and of Askew *et al.* In order to obtain further information, it is proposed to work out the kinetics of these transformations and to determine the quantum efficiencies of the two photochemical processes for light of various wave-lengths, the spectroscopic evidence is, however, already sufficient to indicate that the conversion of ergosterol into calciferol depends on the migration of a double bond to a position in which its influence on the other double bonds is greatly enhanced.

A fuller account of these experiments will be published later, but it is already clear that irradiation



with monochromatic light has very great advantages (as compared with the use of filters) for photochemical experiments in the ultra-violet, especially in the ease and certainty with which an absorbing group can be eliminated from a complex organic molecule by irradiation with light of related frequency. The value of the spectroscopic diagnosis of the structure of the absorbing centres in complex organic compounds will also be rendered much more complete and certain when it is possible to carry out the examination at the temperature of liquid hydrogen, preparations for which are already in progress.

The experiments described above were only possible as a result of the generous co-operation of our biological colleagues in Cambridge and of the Medical Research Council. In particular, we wish to acknowledge our indebtedness to Sir Frederick Gowland Hopkins, Prof J B S Haldane, Mr N W. Pime, and Dr B Woolf of the Sir John Dunn Laboratory of Biochemistry, to Dr L J Harris, Dr T Moore, and Mr T. W. Birch of the Nutrition Laboratory, and to Dr Bourdillon and his collaborators at Mount Vernon.

F P BOWDEN.

C P. SNOW

Laboratory of Physical Chemistry,  
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NATURE, April 16, p 576

### Properties and Structures of Crystalline Vitamins

THE absorption spectra of crystals of ergosterol and calciferol are the same as those of their solutions but for a slight alteration of wave-lengths. The changes produced in solution by irradiation in monochromatic ultra-violet light can also be produced in crystals. They can be observed by the progressive alteration from anisotropic to isotropic material in a polarising microscope. Ergosterol is transformed presumably to calciferol in light of 2967 Å, but scarcely at all in 3650, 3130, and 2537 Å. Calciferol, on the other hand, is stable at 3650 and 2537 Å, but destroyed in 3130 Å. This differs from the behaviour of solutions partly on account of the greater absorption and the formation of protecting layers on the surface of the crystals.

X-ray analysis of crystalline vitamins reveals only the general size and shape of the molecule and is not sensitive to activation. Further work on pyrociferol, suprasterol, and also on cholesterol, cholic acid, and pregnandiol, has shown the essential correctness of my previous suggestions on sterol structure<sup>1</sup>. It is clear that the usually accepted sterol structure must be considerably modified. The crystals of vitamin B<sub>1</sub> show a large, flat cell, and that and their strong negative birefringence point to ring molecules. The same is true of hexuronic acid. The crystals of β-carotene and the related α-crocin do not show the long spacings expected from the constitution of these bodies, but further work is necessary to elucidate their structure.

J D BERNAL

Mineralogical Laboratory, Cambridge.

<sup>1</sup> NATURE, Feb 20, 1932

### The Oldoway Human Skeleton

IN NATURE of Feb 27, p 312, Messrs Forster Cooper and Watson set out the reasons by which they are "forced to the conclusion that the Oldoway man reached the position in which he was found by an artificial and probably a relatively recent burial". Among the reasons which they adduce for this conclusion is the fact that the "skeleton, which is of modern type, with filed teeth, was found completely articulated down even to the phalanges, and in a position of extraordinary contraction". As field palaeontologists, they regard the possibility of a

skeleton getting into the deposits in such a state by *natural means* as so unlikely, that they find it hard to believe that the skeleton was contemporary with the deposits in which it lay.

In our letter in NATURE of Oct 24, 1931, p 724, we stated our conclusion "There is no possible doubt that the human skeleton came from Bed No 2 and not from Bed No 4", and we also stated that "Beds Nos 3 and 4 overlie Bed No 2 conformably", but we made no statement that the skeleton was deposited in Bed No 2 without artificial aid.

Personally, I am quite in agreement with Messrs. Forster Cooper and Watson that a *complete articulated human skeleton in the contracted position* is not likely to become buried in a lake deposit by natural agencies, but I have never claimed that that happened with the Oldoway skeleton, although I am aware that Prof Reck did formerly make such a claim.

I am, however, quite satisfied, after examining all the evidence, that Bed No 3 at Oldoway, with its 50 per cent extinct fauna, was laid down after the skeleton became embedded in Bed No. 2, and that the skeleton was certainly not a *subsequent* burial into the deposits. My own personal belief is that contemporary man, living on the edge of the then existing Oldoway lake, buried the skeleton into the muddy, clayey edge of the lake whilst Bed No 2 was in process of being deposited, for Bed No 2 is essentially a shallow water deposit at the place where the skeleton was found. Bed No 3, which is of a brilliant red colour and of quite a different texture, was then deposited above it.

It would take too much space to set out here all the geological and other evidence which shows that the skeleton was already in Bed No 2 before Bed No 3 was laid down, but I may perhaps summarise some of the chief reasons, as follows.

Bed No 2, which contained the skeleton, is of a yellow colour, and the skeleton lay in its topmost levels. Immediately over it lies Bed No 3, which is red in colour and of a quite different texture.

The position of the skeleton was such that unless it had been buried into the deposits within the last few years (at most fifty) any supposed grave-digging into Bed No 2 must also have affected Bed No 3, and it thus follows that, unless the skeleton was a burial of the past very few years, the refilling of the grave must have resulted in an admixture of red and yellow material around the body.

I was lucky enough personally to examine the skeleton at Munich while it was still intact in its original matrix, and could detect no trace whatever of such admixture, or of disturbance.

The bones of the skeleton, while not so heavily mineralised as those from Bed No. 3 or even Bed No 1, are, so far as I know, every bit as mineralised as most of the bones from Bed No 2 itself. This less complete mineralisation is presumably due to the varying nature of the deposits.

I have personally examined the so-called 'filing' of the teeth of the Oldoway man on the original specimen at Munich, and this 'filing' has no resemblance to any filing done by native tribes to-day, and it is, to my mind, exceedingly doubtful if it can be called filing at all.

I hope that Messrs Watson and Forster Cooper will have been satisfied by this statement of mine, incomplete though it is, but I should like to give them still further evidence in support of the genuineness of the antiquity of *Homo sapiens* in East Africa.

During the past six weeks, I have been carrying out investigations on the north-east shore of Victoria Nyanza, at the well-known fossil beds in the region of Kendu and Homo on the south side of the Kavirondo Gulf.

My results there have far and away exceeded my expectations, and amply corroborate the conclusions we came to at Oldoway. A series of old lake beds was examined which yielded a fauna and a culture sequence similar to that of the Oldoway Beds Nos 1 to 4. The beds were found to contain teeth of a giant *Demotherium* of the same type as that from Bed No 1 at Oldoway, in association with tools of Pre-Chellean type exactly as at Oldoway. This same bed also yielded teeth of an extinct elephant apparently (I have only Zittel available) closely allied to, if not actually a species of, *Tetrabelodon*. The later beds contain *Elephas antiquus* sp., *Hylochoerus* sp., *Hipparion* sp., *Pelorovis* (?), and other animals typical of the higher Oldoway beds, together with tools of the Chellean type.

Actually *in situ* at a place called Kanam, in the same horizon as the Pre-Chellean tools and the *Demotherium*, we found a fragment of a mandible of *Homo sapiens* type, thus putting *Homo sapiens* in East Africa back one stage further than Oldoway man—in fact, in deposits of the same age as Bed No 1 at Oldoway. The horizons which have yielded the Chellean tools have not yielded, unfortunately, human remains actually *in situ*. We have, however, found fragments of the skulls of three different individuals of *Homo sapiens* type completely mineralised and just washed out of the exposures by the rains. They are in the same state of complete mineralisation as the remains of *Elephas antiquus*, *Hipparion*, etc., from the same beds, and I have personally no doubt whatever that they were *in situ* a month or two ago, before the beginning of the present rainy season. These later remains are probably, then, the contemporary of the Oldoway skeleton, and since we have fragments which make up the greater part of the skull cap of one of the individuals, an interesting comparison will be possible later on.

In conclusion, I may record the discovery of teeth, with fragments of upper and lower jaws, of several individuals of a very interesting anthropoid ape in deposits of apparently Miocene age on Rusinga Island. The associated fauna includes creodonts, a small primitive rhinoceros, very numerous remains of a small *Demotherium* about half the size of the Oldoway *Demotherium*, and numerous other unidentified teeth and bones. I hope to be able to make a further communication about this anthropoid shortly.

L S B LEAKEY

East African Archaeological Expedition,  
P O Box 40, Limuru, Kenya, April 19

#### Modification of Light Quanta by Elastic Heat Oscillations in Scattering Media

IN my previous communications<sup>1</sup> I pointed out the existence of a new type of modified radiation produced by scattering of light in liquids and crystals, which may be ascribed to the interaction of light waves and the acoustic oscillations in the medium.

Recent experiments with carbon disulphide and chlorobenzene have fully confirmed the results obtained previously with other liquids. The unmodified and modified components in the case of these liquids are very diffuse. The observed and calculated values of the displacements of components are given in the accompanying table.

|                   | $\Delta\lambda_{\text{obs}}$ in Å | $\Delta\lambda_{\text{calcul}}$ in Å |
|-------------------|-----------------------------------|--------------------------------------|
| Carbon disulphide | 0.049                             | 0.040                                |
| Chlorobenzene     | 0.047                             | 0.042                                |

In Fig 1 microphotometer curves of spectrograms from benzene at scattering angles  $\theta = 90^\circ$  and  $\theta = 135^\circ$

are shown and the unmodified and modified components can be seen quite clearly. The results of the measurements of these spectrograms are given in Table 2 in my previous note<sup>2</sup>.

The appearance of the central unmodified line, which should not be present according to the Brillouin-Mandelstam theory,<sup>3</sup> may possibly be explained by superposition of unresolved modified lines due to

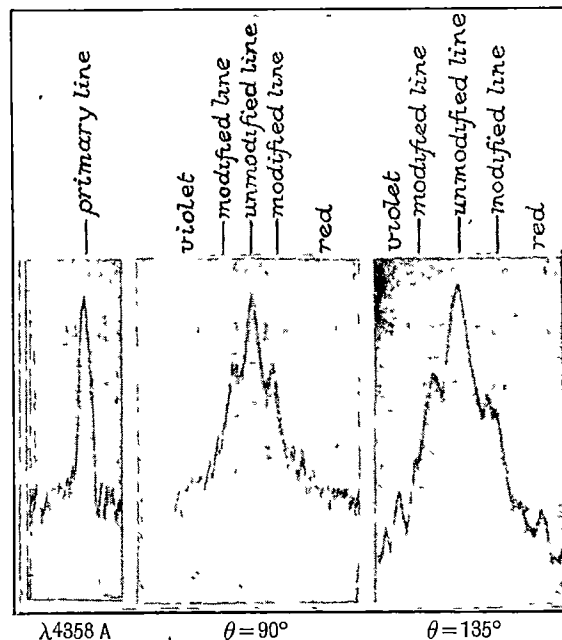


FIG 1

reflections of higher orders. These reflections arise from heat waves of wave-lengths 2, 3, 4, times greater than that which produces the first order reflection with the change of the frequency determined by the equation

$$\Delta\nu = \pm 2\nu_0 \frac{v}{c} \sin \frac{\theta}{2}$$

The modification of frequency produced by reflections of higher orders should be 2, 3, 4, times less than that given by this formula. The superposition of these unresolved modified lines may give rise to the appearance of the broadened central 'unmodified' line. The identity of polarisation of 'unmodified' and two adjacent modified lines<sup>4</sup> is in accordance with this view.

In all liquids as yet investigated, I have been unable to detect any displacement of the scattered line towards the red ( $c = 0.05 \text{ Å}$ ) as was described by Cabannes and Salvaire<sup>5</sup>. I was also unable to find such displacement in the same two liquids (benzene and ethyl alcohol), which were investigated by Cabannes and Salvaire. With my apparatus I could easily detect much smaller displacements than those ( $0.035 \text{ Å}$  and  $0.05 \text{ Å}$ ) observed by these authors.

To make this point clear, Mr Khvostikov and I undertook a careful comparative examination with an echelon grating of light scattered by benzene and by optical glass. It has been shown<sup>6</sup> that optical glass does not produce any noticeable modification in the scattered light. During the whole time of exposure, the spectra produced by benzene and glass were photographed simultaneously side by side on the same photographic plate. It was found that the central component of benzene coincides with the single line (unchanged original line) given by optical glass, and

two modified components of benzene are situated symmetrically on both sides of it

Further investigations were undertaken with styro-  
lene ( $C_8H_8$ ). In this amorphous solid, Cabannes has  
found<sup>7</sup> a displacement towards the red of the scattered  
line similar to that in liquids. With this substance  
also we were unable to confirm the observations of  
Cabannes. In accordance with what would be expected  
from theoretical considerations,<sup>6</sup> neither broadening  
nor displacement of the line scattered by styro-  
lene could be detected.

Recently the experiments on the structure of  
the scattered lines were repeated by Vacher<sup>8</sup> and  
Rafałowski.<sup>9</sup> Using a Fabry and Perot interferometer,  
Vacher was unable to detect the modified lines found  
by me. He could not find any splitting (structure) of  
the scattered line, but only the broadening and the  
displacement towards the red of the original line. Thus  
his results agree with those of Cabannes and Salvaire.

Rafałowski, using a Lummer-Gehrcke plate, also  
was unable to confirm my observations. The modified  
lines observed by me should appear in the spectrum  
half-way between the neighbouring orders of the  
primary line. He found, however, that the spectrum  
of light scattered by benzene differs from that scattered  
by white paper (that is, arc spectrum) only by  
continuous background and by a slight broadening  
of lines.

I repeated, therefore, with a large glass Lummer-  
Gehrcke plate (1 cm  $\times$  4 cm  $\times$  30 cm), the comparative  
examination of light scattered by benzene and by  
optical glass described above, although I believe that  
a Lummer-Gehrcke plate is less suitable for the  
examination of the phenomenon than an echelon  
grating. Owing to overlapping of different orders,  
the structure of the scattered line could not be  
resolved (the distance between neighbouring orders of  
my Lummer-Gehrcke plate is only 0.07 Å at  $\lambda 4358$  Å).  
The photograph showed a continuous blackening in  
the case of benzene, whereas optical glass gave well-  
defined interference fringes.

These results are in agreement with my previous  
experiments with an echelon grating and confirm the  
existence of modified lines of nearly the same intensity  
as the unmodified one, and disagree with Rafałowski's  
observations.

A detailed account of the experiments will be pub-  
lished in the *Zeitschrift für Physik*.

E. GROSS.

Optical Institute,  
Leningrad, Feb. 20

<sup>1</sup> NATURE, 126, 201, 400, and 603, 1930

<sup>2</sup> NATURE, 126, 201, 1930

<sup>3</sup> L. Brillouin, *Ann. Phys.*, 17, 88, 1922, and L. Mandelstam, *J. Russ. Phys.-Chem. Soc.*, 58, 831, 1926

<sup>4</sup> NATURE, 126, 400, 1930

<sup>5</sup> J. Cabannes and P. Salvaire, *C. R.*, 188, 907, 1929

<sup>6</sup> *Z. Physik*, 63, 685, 1930

<sup>7</sup> J. Cabannes, *Trans. Faraday Soc.*, 25, 813, 1929

<sup>8</sup> M. Vacher, *Phys. Ber.*, 12, 1044, 1931, and *C. R.*, 191, 1121, 1930

<sup>9</sup> St. Rafałowski, *NATURE*, 128, 495, 1931

### Isotopic Displacement and Hyperfine Structure

THE analysis of the hyperfine structure of thallium  
and mercury<sup>1</sup> has led to the discovery of a structure  
which is not due to the spin of the nucleus but to a  
displacement of the atomic levels in different isotopes.

Recently, Bartlett<sup>2</sup> has carried out some calcula-  
tions on the order of magnitude of these displacements,  
assuming deviations from the Coulomb law near the  
nucleus, he assumed the potential energy to have a  
constant value  $V_0$  for distances smaller than a certain  
critical radius  $r_m$ , where  $r_m$  may be called the radius  
of the nucleus. His calculations led to an agreement  
as to the order of magnitude of the displacement of

atomic levels with those found experimentally, if  
 $r_m$  was chosen to be equal to  $10^{-12}$  cm and  $\delta r_m$  (for  
different isotopes) of the order of  $10^{-13}$  cm. These  
values are of the same order of magnitude as those  
to which Gamow's theory of the  $\alpha$ -decay led.<sup>3</sup>

However, Bartlett's method of calculation is very  
rough, as he works out the energy of perturbation  
with the help of eigenfunctions of hydrogen-like atoms,  
not taking account of the screening of the nucleus by  
the core electrons. This, of course, would result in a  
considerable over-estimation of the displacement, if  
it were not compensated by the omission of a factor  
 $\sqrt{Z^3/n^3}$  in the coefficient of normalisation. Further-  
more, Bartlett is neglecting relativity corrections,  
which, according to our calculations, are not in-  
appreciable, owing to the fact that the eigenfunctions  
become infinite at the origin.

We have worked out the displacements using eigen-  
functions of the relativistic equation, normalising  
them so as to be asymptotically equal to the Schrod-  
inger eigenfunctions for large values of  $r$ . We find<sup>4</sup>  
that for  $s$ -electrons the electronic density near the  
nucleus becomes

$$\frac{2(1+\rho)\psi^2(0)}{[\Gamma(2\rho+1)]^2} \left(\frac{2Zr}{a_1}\right)^{2\rho-2}$$

where

$$\rho = \sqrt{1-\gamma^2}, \quad \gamma = Za = \frac{2\pi Ze^2}{hc} \sim \frac{Z}{137},$$

$a_1 = \frac{h^2}{4\pi^2 me^2}$  = radius of the Bohr orbit of hydrogen,  
and  $\psi(0)$  the value of the unrelativistic eigenfunction  
in the origin, which has to be worked out numerically  
with the help of the Thomas-Fermi potential.

From this we derive for the displacement  $w$  of an  
 $s$ -term, assuming for the potential inside the nucleus  
 $V_0 = -\frac{Ze^2}{r_m}$

$$w = \frac{8\pi(1+\rho)\psi^2(0)}{[\Gamma(2\rho+1)]^2 hc} \left(\frac{2Z}{a_1}\right)^{2\rho-2} \int_0^{r_m} \left(\frac{Ze^2}{r} - \frac{Ze^2}{r_m}\right) r^{2\rho} dr$$

$$= \frac{8\pi(1+\rho)\psi^2(0)}{[\Gamma(2\rho+1)]^2 (2\rho+1) hc} \left(\frac{2Z}{a_1}\right)^{2\rho-2} Ze^2 r_m^{2\rho} \frac{1}{2\rho}.$$

The relative displacement  $\delta w$  of two isotopes with  
a difference  $\delta r_m$  between the radii of their nuclei  
becomes therefore

$$\delta w = \frac{8\pi(1+\rho)\psi^2(0)}{[\Gamma(2\rho+1)]^2 (2\rho+1) hc} \left(\frac{2Z}{a_1}\right)^{2\rho-2} Ze^2 r_m^{2\rho-1} \delta r_m$$

For mercury we find  $\rho = 0.81$ ,  $\psi^2(0) \sim 3 \times 10^{26}$  cm<sup>-3</sup>,  
and

$$\delta w \sim 2.5 \times 10^{22} r_m^{0.62} \delta r_m \text{ cm}^{-1}$$

Assuming, as Bartlett,  $r_m = 10^{-12}$  cm,  $\delta r_m = 10^{-13}$  cm,  
we get

$$\delta w \sim 100 \text{ cm}^{-1},$$

which is several hundred times larger than the experi-  
mental value.

It appears now unlikely that  $r_m$  should be con-  
siderably smaller than  $10^{-12}$  cm in order to get the  
experimental values of the displacement, we would  
therefore have to assume  $\delta r_m$  to be of the order of  
 $10^{-16}$  cm, that is,  $\frac{\delta r_m}{r_m} = \frac{1}{10,000}$ . This seems scarcely  
compatible with the fact that the difference in mass  
of successive isotopes is about one hundredth of their  
total mass.

One could question the validity of Schrodinger's  
method of perturbations, as in our case the perturba-  
tion, though extending only over a very limited area,  
is very large. But we may satisfy ourselves with  
respect to this objection in the following way. For  
the type of potential curve near the nucleus assumed

here and a Coulomb field farther outside, the solutions of the Dirac equations can be found accurately, without using approximations, in this case we found good agreement with the approximative method.

My thanks are due to Prof. Pauli and Dr. Delbruck for helpful discussion.

GIULIO RACAH.

Physical Institute,  
Eidg. Techn. Hochschule,  
Zurich, Jan. 27

<sup>1</sup> Schuler and Keyston, *Z. Phys.*, 70, 1, 1931, 72, 423, 1931.

<sup>2</sup> *NATURE*, 128, 408, 1931.

<sup>3</sup> Gamow, "Constitution of Atomic Nuclei and Radioactivity", Chap. II, Tab. III.

<sup>4</sup> See Racah, *Cim.*, 8, 178, 1931.

### Electric Arc between Carbon and Substances which are Insulators at Ordinary Temperatures

It is well known that glass, chalk, porcelain, etc., become conductors if they are brought to high temperatures. Using this fact, an electric arc can be started between a carbon electrode and a second electrode of these materials.

With a glass electrode the arc is particularly noiseless, even with alternating current (4-5 amperes, 100 volts). The emitted light is a whitish-golden light of warm tonality. Observation with the spectroscope showed a continuous spectrum, which is originated by the pure arc (without the electrodes), and some bright lines. Some dark lines were also observed, and, among them, the *D* lines, which are remarkably strong. If the arc is projected longitudinally on the slit, some of the dark lines (particularly the *D* lines) show a beaded ('venternodalis') feature. This peculiar feature was also observed by me some years ago under different conditions,<sup>1</sup> but in the glass arc is much more marked.

With a chalk electrode the starting of the arc is more difficult.

In order to start the arc with a porcelain electrode, this must be previously brought to a very high temperature. The arc with a porcelain electrode is very white and bright, it has sometimes explosive properties.

MARIANO PIERUCCI.

Physical Institute of the Royal University,  
Modena, Italy

<sup>1</sup> *Nuovo Cimento*, S. VII, vol. 26, pp. 75-76, 1923.

### Vanishing Life of Australia

My attention has been directed to an article in *NATURE* of Sept. 12 last, entitled "Vanishing Life of Australia." As the officer in charge of the Department the function of which it is to protect the native game of this State, a few lines on the subject may not be out of place.

With much of what is said in the article I agree, but some of the statements made are, I fear, rather misleading to the general public. For example, within one hour's motor run of the City of Melbourne—a city of more than one million inhabitants—can be seen kangaroos, lyre birds, and koalas or native bears in their native state, thriving and unmolested by the public. As a matter of fact, there are more kangaroos and wallabies now in this State of Victoria than there were twenty years ago, this being due to adequate protection and the abolition of the market shooter. A similar condition of affairs can be truthfully said to apply to the platypus, that unique paradox which is now common in most of our waters. I have no reason to fear the wiping out of our unique fauna in the immediate future.

The two principal factors in these days accounting for the reduction in numbers of the Australian fauna

are the spread of settlement resulting in the opening up of the country and the difficulty of securing adequate suitable areas for sanctuaries and national parks. However, some of the more beautiful of our cockatoos and parrots, which were nearing extinction a few years ago, have been brought back in greatly increased numbers in recent years, due to strict protection and the proclamation as sanctuaries of their breeding places.

The adequate protection of our rare birds and animals has been made possible by a gradual tightening up of the law. It is now illegal to have in possession, no matter when or where obtained, any of the following birds or animals, or their skins or feathers: Platypus, Koala, Lyre Bird, Rock Pebbler Parrot, Major Mitchell Cockatoo.

This law, which is easy of administration, together with the force of public opinion, has meant not only the preservation of these species, which were tending to become rare, but also their gradual increase, so that they are now more abundant than they were years ago. Furthermore, as an aid in their protection, no permits whatsoever are given to take any of these particular species. Any other native bird or animal may be given the benefit of this special protection at any time, should it be thought there is any need for it, simply by an Order in Council.

These remarks will indicate to your readers that this State of Victoria realises its responsibilities by conserving for future generations the unique birds and animals committed to its care by giving them adequate protection under the law.

F. LEWIS,

Chief Inspector of Fisheries and Game  
143 King Street,  
Melbourne, C.I., Australia,  
Feb. 24

The efforts made, officially and unofficially, to protect the rare creatures of Australia, deserve commendation, but their effectiveness as regards certain species is in some doubt, if we may judge from the opinion of the Council of the Royal Zoological Society of New South Wales (see *NATURE*, Dec. 5, 1931, p. 935). Moreover, Mr. Lewis should have reminded us that the *Melbourne Argus* of Sept. 18, 1931, published six days after our leading article appeared, announced that an individual had been fined £955 5s. for unlawfully consigning 3821 skins of 'opossums', a fact which suggests that the protection afforded by the law is yet far from perfect (see *NATURE*, Jan. 23, 1932, p. 126).

THE WRITER OF THE ARTICLE

### Electrical Potential Differences across Onion Epidermis

R. J. PUMPHREY, in a careful investigation,<sup>1</sup> has found constant electrical potential differences across epidermis stripped from the bulb scales of onions when this membrane separated unlike solutions of electrolytes. We, on the other hand, had previously observed under similar conditions potential differences which changed with time.<sup>2</sup> Pumphrey offers the suggestion that the fall in potential difference in our experiments was due to diffusion of salt from the KCl bridges used to connect the calomel half-cells with the solutions bathing the membrane.

This was an entirely plausible explanation, but we do not believe it to be the correct one, for the following reasons. In our experiments the KCl bridges were removed from the experimental set-up immediately after each observation. In preparation for the succeeding observation their tips were rinsed with the

particular solution with which each was to make contact, and they were then placed in position. In practically all cases the observed potential difference increased with some rapidity during an initial period of considerable duration, during which several observations were made. If this were due to salts diffusing from the bridges, it would be necessary to make the exceedingly improbable assumption that more than ten times as much salt diffused into the more concentrated solution (0.1 N) bathing the membrane as into the less concentrated solution (0.01 N). Somewhat similar considerations apply to the succeeding period of constant potential difference.

After a time the potential difference ordinarily fell off. Pumphrey's explanation applies better here. However, we noted that in general the shorter the period between the readings, the closer was the correspondence between successive readings, the potential varied with the time rather than with the number of insertions of the bridges. When the interval between observations was long and, therefore, the KCl bridges were not being inserted, the potential fell, nevertheless. For example, in one experiment, using 0.1 M NaCl on one side of the membrane and 0.01 M NaCl on the other, the potential fell from 28 mv to 3 mv during an interval of twenty hours during which no observations were made.

It must be recognised that an appropriate combination of convective streaming and diffusion might be imagined, such as would account for the inconstancy of the potential difference in our experiments. Certain other differences between our experimental procedure and that of Pumphrey might be used as a basis for speculation, did it seem worth while. We regard it as preferable to seek an opportunity to repeat our experiments in such a way as to shed further light on the probable causes of the differences between Pumphrey's results and our own.

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R. I. GIESE  
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March 14

<sup>1</sup> Pumphrey, R. J., *Proc. Roy. Soc., B*, 109, 434, 1932.

<sup>2</sup> Brooks, S. C., A. C. Giese, and R. I. Giese, *J. Exp. Biol.*, 8, 124, 1931.

#### Photomicrographic Method for Magnification and Recording in High Speed Pressure Indicators

PRESSURE gauges for recording rapidly changing pressures, such as occur in discharge of firearms or explosions in closed vessels, usually consist of a pressure member which rotates a mirror suitably linked to it. The rotation of the mirror is used to give an optically enlarged indication of the deflexion of the pressure member. These methods have attendant disadvantages. In such gauges we have found it possible to use a photomicrographic method of magnification and recording pressure time curves.

The movement of the pressure member is communicated to an operating rod rigidly connected to the pressure member where the maximum movement takes place. The free end of the operating rod carries a needle at right angles to its longitudinal axis and direction of motion. By means of suitable illumination by light, an enlarged image or shadow picture of the edge of the needle is formed on the film of a drum camera used in photographing the records. The enlarged image is concentrated in a direction normal to the long axis of the needle by means of a cylindrical lens so that a linear image in the form of a black and white line is formed on the film of the camera. The

optical system employed for enlarging and recording the very small motions of the needle attached to the operating rod of the gauge is essentially similar to that used for photographic registration with the Einthoven string galvanometer.<sup>1</sup>

In this manner, by dispensing with mirror systems, we have been able to cut down the mass of the working parts of a rifle pressure time recorder of the piston type to about 10 gm. An example of a pressure time curve



FIG. 1

obtained in discharge of a British service rifle is shown in the accompanying photograph (Fig. 1).

We have also employed the system for closed vessel gauges, and found it useful for recording small motions of various descriptions.

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<sup>1</sup> See "Oscillographs", Irwin, 1925, p. 24.

#### Temperatures of the Wolf-Rayet Stars

In a recent paper<sup>1</sup> C. S. Beals has published the contour of the emission line of ionised helium 4686 in the spectrum of the Wolf-Rayet star H D. 192163. We may suppose that the mechanism of excitation of emission lines in the spectrum of Wolf-Rayet stars is identical with that of planetary nebulae. According to Zanstra's theory, we can obtain the temperature of star from the ratio

$$\frac{\text{whole intensity of line}}{\text{intensity of } I A \text{ of continuous spectrum}}$$

According to the contour of line 4686, this ratio for the star under consideration is nearly equal to 200. Neglecting the presence of other lines of ionised helium, we find from Zanstra's Table 7<sup>2</sup> the temperature  $T = 65,000^\circ$  as a lower limit. For many Wolf-Rayet stars the intensity of line 4686 is much greater, and therefore we may expect even higher values of surface temperature.

V. AMBARZUMIAN

Poulkovo, Observatory,  
Tchuckrjaevka, April 7

<sup>1</sup> *Mon. Not. Roy. Ast. Soc.*, 92, 196, 1932.

<sup>2</sup> *Pub. Dom. Astrophys. Obs., Victoria*, 4, 240, 1931.

#### Planetary Positions on Medieval Maps

A RECENT issue (Feb. 27) of the *Illustrated London News* contained a reproduction of an old map believed to have been used, and possibly drawn, by Columbus. At the side of the world map is a map showing the celestial 'spheres' according to the Ptolemaic system. It is of special interest because it shows the positions\* of the heavenly bodies approximately as follows: Sun, Aries 0, Moon, Libra 0, Mercury, Aries 22, Venus, Aquarius 17, Mars, Cancer 2, Jupiter, Virgo 7, Saturn, Scorpio 22.

\* Degrees are not given in the figure. I have merely estimated the degree according to the distance of each planet from the commencement of the sign in which it is placed.

The placing of the planets is not symmetrical, nor are they placed symbolically, for example, in the signs described as the 'exaltations' of the planets by Ptolemy. Probably, therefore, they are either placed in the figure at random or are intended to show the positions of the planets at a specific epoch.

Calculation shows that on no day within the last three thousand years were all the planets in or near the positions stated. But if we suppose that the man who first drew the figure was an observer, not a calculator, that his deductions as to position were made from observations extending over a few weeks, and that he could not see Mercury, but merely guessed its position, the celestial 'theme' may have been originally drawn in March A.D. 131. By the time of full moon on March 31 the positions were approximately Sun, Aries 7, Moon, Libra 7, Mercury, Pisces 10½, Venus, Pisces 9½, Mars, Cancer 2; Jupiter, Virgo 20½, Saturn, Scorpio 21. Venus had been near Aquarius 17 about March 12.

The period of Roman rule in Egypt was a period of astronomical activity. Not only have we the works of the famous astronomer Ptolemy from that period, but quite a number of horoscopes. In these the planetary positions are sometimes given fairly accurately, but in others, for example, the horoscope of Tryphon (A.D. 16), and the horoscope of Anubion (A.D. 137), the position of Mercury is quite wrongly given.

The same period is known also to have been a period when there was an interest in map-making, and it is quite conceivable that the map-maker of the fifteenth century copied the figure of the heavens from some older map without knowing what it represented.

I should be glad if anyone who knows about any maps of the Middle Ages, with planetary positions marked on them, would give me information in regard to them.

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Edinburgh,  
March 31

#### Halibut Liver Oil as a Source of Vitamin A

REFERENCES in the literature that the liver oil of the halibut (*Hippoglossus vulgaris*) is a very rich source of vitamin A (of the order of 50-100 times as rich as cod-liver oil) have been confirmed by me. However, it was soon found that not all samples of halibut liver oil gave such high values, and all potencies from 30 blue units (0.2 c.c. of 20 per cent solution) up to 1600 blue units have been observed. It is to be noted that this irregularity is the rule, and not the exception, in my experience. If halibut liver oil is to become of commercial value as a ready-made vitamin A concentrate (and this possibility is at present being investigated by several manufacturing firms), it is clearly necessary to know something of these fluctuations, whether they are seasonal, etc. This is all the more necessary as, for some reason at present unknown, halibut liver oil cannot be obtained by steaming the livers (as with cod liver oil, for example), and the more expensive process of solvent extraction must be resorted to.

A prolonged series of experiments on this problem of the excessive fluctuations in vitamin A potency of halibut liver oil is being carried out, and attempts will be made to find not only the seasonal effects (if any), but also the influence of the diet of the fish concerned. The work is not sufficiently advanced as yet to draw any definite conclusions.

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No 3263, Vol. 129]

#### Implements of Late Magdalenian Age underlying the Raised-Beach at Larne, Co. Antrim

IN July 1930 I made the discovery that the Lower Estuarine Clay of north-east Ireland contains a pencontemporaneous and well-developed flint industry of Late Magdalenian age. Subsequent investigations in the company of my friend Mr. C. Blake Whelan resulted in the recovery of several hundreds of these artefacts from the two small exposures of Lower Estuarine Clay on the western shore of Island Magee.<sup>1</sup> The type specimens, exhibiting a distinctive blue patination, have been fully described and illustrated in my last paper.<sup>2</sup>

Lately I have established the fact that the Lower Estuarine Clay which underlies the gravels of the 25-foot raised-beach on the Curran at Larne contains a similar industry to that previously located on Island Magee.

Elsewhere I have, upon archaeological grounds, suggested that a considerable period elapsed between the deposition of the Lower Estuarine Clay and the gravels of the 25-foot raised-beach.<sup>3</sup>

Sections on the Curran appear to offer geological support to the above conclusion. Not only is there evidence that the Lower Estuarine Clay had suffered substantial surface erosion prior to the deposition of the gravels of the 25-foot raised-beach of Early Neolithic times,<sup>4</sup> but also that the period of erosion was followed by the formation of marine sands characterised by a molluscan fauna of wider range in types than that of the overlying raised-beach gravels.<sup>5</sup>

J. P. T. BURCHELL

30 Southwick Street,  
Hyde Park, W 2, April 9

<sup>1</sup> NATURE, 128, 133, July 26, 1930

<sup>2</sup> Proc. Preh. Soc. E. Anglia, vol. 6, pt. 4, pp. 270-81, 1931

<sup>3</sup> Loc. cit., pp. 285 and 287

<sup>4</sup> Praeger, Proc. Roy. Irish Acad., vol. 4, ser. 3, Pl. 1 (Fig. 3), 1896

vol. 25, sec. C, Fig. 3, 1904

<sup>5</sup> Praeger, Proc. Roy. Irish Acad., vol. 4, ser. 3, pp. 39-40, 1896

#### Proper Name of the Amœba

THE common little amœba of stagnant waters appears to have no well-established scientific name. I have, to-day, received an elaborate paper, by S. O. Mast and P. L. Johnson, published in *Archiv für Protistenkunde*, 1931, intended to settle the matter. These authors give many apparently good reasons for thinking that the "Kleine Proteus" of Rosel (1755) was in fact a myxomycete. Hence the names applied by Linnæus and Pallas to this organism are not applicable to the amœba.

The final conclusion reached is that the valid name must be *Amœba proteus* Leidy, 1878. But Leidy expressly states that he is using the specific name coined by Pallas, 1766 (*Volvox proteus*). There are no grounds whatever for attributing the specific name to him, and no matter what he described, the type of *A. proteus* is the organism referred to by Pallas.

The generic name *Amœba* is an emendation from *Amiba*, as Leidy states. The earliest specific name under *Amiba*, and the type of the genus, is *A. divergens* Bory, 1822. With this stands or falls the generic name. Apparently the oldest specific name for an amœba in the modern sense is *Proteus diffuens*, which Sherborn ascribes to G. Adams, 1787 (not Muller, 1786, as commonly cited). Mast and Johnson do not think this is identical with the *Amœba proteus* of modern authors, but Schaeffer, who paid much attention to the subject, so considered it. What, then, is the proper name of the common amœba?

T. D. A. COCKERELL

University of Colorado,  
Boulder, Colorado, March 22



## Research Items

**Marriage in Africa**—In *Man* for April, Mr J H Driberg discusses the character of State marriages—the marriages of chiefs and rainmakers—in Africa, and argues that they are not, as is usually held, outside the ordinary rules of African marriage. The ruler's official wife is not his first wife, but the wife he marries after his accession to office. The marriage wealth is not paid by the husband, but is contributed by the whole tribe, and however many marriages the chief may have contracted before, and however many children he may have had, it is the State wife, the cattle for whose marriage has been publicly subscribed, who provides the heir. But if the tribe is the logical and organic development of the family through the clan, this marriage also would have had the clan recognition. Every eldest son of an eldest son, as the representative of his local community, has a State wife, provision for whose marriage has been made by the community at large. This is his first wife. The purpose of the marriage is to ensure continuity and to make possible the reincarnation of an ancestor. The clan is intimately concerned in the provision of a first wife of a member whose status will involve certain religious and economic duties. Therefore, the clan must contribute at least a proportion of the marriage wealth. Occasionally a young man may acquire sufficient wealth to make him economically independent. Even when this happens, the clan will insist on providing a portion of the marriage wealth in order to assert its rights. If, however, the first marriage is contracted without the assistance of the clan, it is not recognised as a clan transaction. The children have no clan affiliation, but form a new clan, of which the husband is the eponymous founder.

**Yurok-Karok Basket Weavers**—A study of the basketry craft of the Indians of the Klamath and Trinity Rivers, California, by Miss Lila M O'Neale (*University of California Publications in American Archaeology and Ethnology*, vol 32, No 1), may be noted as dealing more specifically with the relation of the women to their work than with the technological side of the subject. The basket-work of these Indians has long been marked for its attainment of a high degree of excellence. It is limited, with the exception of minor matters of finish, to the twining technique. In material, form, proportions, and stylised design motives it is moulded by a set of traditions which have been transmitted from generation to generation. As a woman's baskets are destroyed at her death, no baskets of great age are in existence among the Indians themselves. Although the Indians have been in contact with the whites since 1850 and modern ideas have not entirely failed to penetrate, the women who at present make baskets are conscious of the deviations and judge to-day's products by yesterday's criteria. The teacher of the basket maker is generally the mother, if she is living, otherwise the grandmother or an aunt. The child is generally five or six years of age when her first basket is started for her, but it may be another five years before she is able to start a basket for herself. Grown women refer to their training with pride. The actual weaving of a basket presupposes days of preparation in gathering, preparing, sorting, and storing of materials. Small children, extreme old age, or physical disability are the only excuses for not engaging in this preparatory work, and such failure is regretted, as each woman knows that her choice of material for her own work is superior to that of anyone who may do it for her.

**Zebu-Yak Hybrids**—For several years, crosses have been made between zebu Indian cattle and yaks in the Zoological Park at Moscow. Mr M M Zavadovsky has published an account of the results (*J. Heredity*, vol 22, No 10). A zebu bull was originally crossed with a yak cow, producing a female, which was repeatedly crossed with its father. Crosses of the offspring were also made with a hornless yak bull, a total of 14 hybrid animals being produced from this bigeneric cross. The  $F_1$  and  $F_2$  females are fully fertile with both parent species, while the male hybrids are sterile and are shown histologically to produce no sperms. A study of the chromosomes might throw further light on this male hybrid sterility. Heterosis or hybrid vigour occurs in this, as in certain other crosses among the Bovidae. The characters the inheritance of which was studied included coat colour, length of hair, the 'fringe' of the yak, length of tail hair, and shape of hump, horns, and muzzle. The dominance is frequently incomplete, but there is clear evidence of Mendelian segregation when the  $F_1$  is crossed back to either parent. The zebu is grey with short hair, the yak black-brown with long hair and a fringe. The  $F_1$  animals have the yak colour but with hair scarcely longer than the zebu. In back-crosses the black-brown animals were grey-brown until the first coat was shed. The fringe of the yak is almost completely recessive, while the yak type of tail is incompletely dominant, giving intermediate lengths of hair in back-crosses. The yak shape of hump is partially dominant to that of the zebu, the hybrids having no hump at first but developing one in after years. The horns of the  $F_1$  generation are different from either parent, and probably at least two pairs of genes are concerned. The muzzle of the hybrid is intermediate but nearer the zebu, and there is evident segregation in the next generation. Absence of horns is dominant in yak hybrids, as in cattle.

**Origin of the American Fauna**—The discovery of a wide range of mammalian fossils in America has made possible a well-documented history of this group. Briefly, three main elements are concerned: a northern, circumpolar, modern element; a more southerly, older element, and a still more southerly, still older element, the original fauna of South America. It can scarcely be expected, as Emmett Reid Dunn has pointed out (*Copeia*, Oct 1930, p 106), that reptiles and amphibians should show elements so clear-cut as to origin, for they make poor fossils, they cannot stand cold climates and therefore the northern element will be weak, and they are more subject to accidents of environment. Notwithstanding these difficulties, the author's analysis of the distribution of American turtles and other groups of reptiles and amphibians shows that in the basal elements of the herpetological fauna there is surprising agreement with the scheme formulated for the mammals.

**Nematode Disease of Potatoes**—Extensive work on the nematode disease of potatoes has been carried out by Dr D G O'Brien and Mr E G Prentice (*West of Scotland Agric Coll Res Bull* No 2, 63 pp). The history of the study of the parasite is reviewed, and detailed descriptions of the symptoms which it causes on potatoes are given. Variations in morphology, due to adaptation, occur and are described minutely. The relation of the organism to soil environment and its distribution have also received attention. One important fact is that the nematode disease is often

followed by secondary parasites, the chief of which is *Rhizoctonia solani*. The presence of the fungus appears to aggravate the disease, causing 'nematode nests', that is, areas in the potato crop where the plants are unhealthy and rot prematurely. It is interesting to recall, in this connexion, the results of other work (see NATURE, March 5, 1932, p. 367) showing that *Heterodera Schachtli* is mainly responsible for the disease of potatoes known as 'sickness', with which *R. solani* may also be associated as a secondary parasite. Potato sickness and nematode disease are, presumably, but two names for the same malady.

**Climatic Synopsis of Manila**—The annual summary of monthly meteorological data for Manila for each year is in the form of a single sheet two feet wide and more than a foot from top to bottom—a rather awkward-sized document to study. The sheet for 1931 was available in London early in March, a notable feat of the Manila Central Observatory. This Observatory is probably best known to meteorologists as contributing so much to our knowledge of the structure of the typhoons of the Philippines. Manila lies approximately in lat. 15° N and is near the western extremity of the world's largest stretch of tropical ocean, it fails to be ideally placed for providing information about cyclones only in so far as land influences are present owing to the large size of the island of Luzon. The irregular visits of these violent disturbances are to a region which is normally one of extraordinary tranquillity, where barometric pressure may show only the same systematic slight changes according to the time of day for weeks in succession. At Manila, moreover, temperature has varied over a total range of only 43° F since the beginning of 1885—a range occasionally surpassed in less than twelve hours even in the temperate climate of England. Alongside the figures for the different climatic elements for 1931 long period averages are given. These will enable anyone interested in the weather of this part of the Far East to find points of interest in what appears at first sight to be only a dreary collection of statistics, it is a pity, nevertheless, that some short note on outstanding peculiarities of each year cannot be added to supplement the tables.

**Penetrating Radiation from Beryllium**—Dr J. Chadwick's suggestion (NATURE, 129, 312, 1932) that the penetrating radiation produced when beryllium is bombarded with  $\alpha$ -particles consists of neutrons has been discussed by F. Rasetti in *Die Naturwissenschaften* (April 1, p. 252). Rasetti has obtained results in agreement with the neutron hypothesis, in that he has been able to repeat the earlier work with the Wilson expansion chamber, and to photograph trails attributed to hydrogen, helium, and carbon nuclei which have received energy from the neutrons. His work is not obviously in accord with this, in that it appears quite easy to prevent individual units of the beryllium radiation from passing consecutively through both of two Geiger-Müller counters, coincident discharges of the two can be completely stopped by the interposition of 5 mm of aluminium between them, which should not affect neutrons appreciably. This corresponds, however, to the absorption of electrons set free by the recoil from a 10 million volt  $\gamma$ -ray quantum, and to overcome this difficulty it is suggested that the beryllium radiation is a mixture of both neutrons and  $\gamma$ -rays.

**Examination of Turbulent Flow with an Ultramicroscope**—A. Fage and H. C. H. Townend have described an ultramicroscope method for studying turbulent flow which has been developed at the National Physical Laboratory (*Proc. Roy. Soc.*, April). Ordinary tap water contains many particles which can be used

for this purpose, being small enough to show Brownian movement when the water is at rest, and appearing in the objective as bright streaks when strongly illuminated with the fluid moving. The local movement of the fluid can be found from the appearance of the streaks. Although it was found that only ocular observations could be made, photographic recording proving impracticable, the method is specially valuable, both because no instruments have to be put in the fluid and because the use of a microscope restricts the volume under observation at any instant. The results are not readily compared with von Kármán's theory of turbulence, but the prediction that the velocity fluctuations on the axis of the pipe are zero is wrong, fluctuations amounting to 20 per cent of the mean rate of flow being observed. At the wall, the flow tended to a laminar type, but the motion of the particles in the laminae remained sinuous even to within 1/40,000 in. of the boundary, no particle being seen to move in a rectilinear path. A further observation made was that as the rate of flow was increased through the critical range of the Reynolds's number, the changes of flow occurred with great suddenness, there was no sign of a growth in the degree of turbulence, but only a change in the relative frequency and duration of rectilinear and turbulent flow.

**Magnetostriction in Strong Fields**—In three recent papers (*Roy. Soc. Proc.*, April) Prof. P. Kapitza has extended considerably the theory of the change in dimensions of a body in a magnetic field and the technique for measuring this. The first paper contains an account of the generalised thermodynamics of the effect for crystals, based largely on Voigt's work. The second describes the modifications necessary in the magnetic balance to convert it into an extensometer, the extraordinarily high sensitivity to length changes of  $2 \times 10^{-7}$  cm has been attained. In the third, the new methods are applied to a detailed study of bismuth and a less complete study of antimony and some other feebly magnetic bodies (graphite, gallium, tungsten, tin, beryllium, magnesium, and rock-salt), not all of which gave a measurable effect. For bismuth, the change in length in weak fields is proportional to the square of the field in all circumstances, but in strong fields at low temperatures there is marked deviation from this law. The sign of the effect is different for the trigonal and perpendicular axes, and the total effect quite small on this account in multicrystalline specimens. For certain axes in bismuth an irreversible change occurs, which has been called 'magneto-slipping'. This is the first occasion on which magnetostriction has been observed for other than ferromagnetic substances, and the experiments are to be extended to transverse and volume effects, whilst the results of some experiments on ferromagnetics in strong fields have still to be published.

**The Quinhydrone Electrode**—Lammert and Morgan (*J. Amer. Chem. Soc.*, March) report further experiments with the quinhydrone electrode which will be of interest to users of this apparatus. They find that, in acetate and phosphate buffer solutions of pH 4.6–5.0 and 6.1–6.5 respectively, it gives results of fair precision, the average potential differences between two like electrodes being about ten times as large as the corresponding averages in 0.1M hydrochloric acid. In unbuffered salt solutions in the neutral range, however, the behaviour may be very erratic, particularly if gold or graphite electrodes are used, and the error, due to lack of reproducibility, may be far greater than any constant error calculated by Sørensen and described as 'salt error'. The rôle of the electrode substance in the quinhydrone half

cell cannot be neglected, and must be tested for each particular system in which the electrode is to be used. The authors conclude that the quinhydrone half-cell, whilst providing an excellent secondary standard, must be used with great discretion as a working electrode, its use being preceded by a study of its reproducibility in the system under investigation.

**Micro-Methods and Enzyme Studies**—Almost the whole of our knowledge of enzyme action is based on the behaviour, *in vitro*, of enzymes isolated from the tissues. While this may give valuable information of the mode of action of enzymes secreted from the tissues, it is clear that for the majority of intracellular enzymes there can be no comparison between the conditions in the reaction medium, *in vitro*, and those which obtain in the cell. Furthermore, the methods of extraction themselves are in many, if not most, cases such as to leave it certain that radical alterations in the properties of the enzymes will ensue during extraction. The recognition of problems such as these has led K. Linderström-Lang and H. Holter (*C R Lab Carlsberg*, 19, No 4, 1931) to consider what degree of refinement in existing methods is required. In their judgment, an increase of delicacy of about one hundred thousand times would suffice to study the enzymatic activity of a single cell, but methods capable of measuring changes one thousand times as small as those detected by current macro-methods would remove most of the difficulties experienced. They have therefore devised a method of this degree of refinement for following the hydrolysis of a peptide by malt peptidase. The amino nitrogen is estimated in acetone by titration with *N*/20 alcoholic hydrochloric acid and naphthyl red, thus eliminating the effects of carbon dioxide on the end point. The apparatus is simple, and the mean error on a titration

of 20 c mm is of the order of 0.03 c mm. Now a section of a root  $40\mu$  thick weighs approximately 0.003 mgm and it contains only about 300 cells. This, in suitable circumstances, will break down sufficient peptide to give a result thirty times greater than the probably experimental error. Evidently, on this basis, the presence or absence of activity in 10-20 cells could be demonstrated.

**Creep Tests on Steel for Steam Plant**—In a paper entitled "Testing of Materials for Service in High-Temperature Steam-Plant", by R. W. Bailey and A. M. Roberts, read to the Institution of Mechanical Engineers on Feb 19, particular reference was made to the creep tests required for steels used for turbine discs and cylinders, steam pipes, boiler tubes, superheater tubes, and bolts for steam joints, which during their working life are subject to stress at high temperatures. The subject of creep, which has become of increasing importance in power station practice, was first brought before the Institution in 1924 by Prof. F. C. Lea, whose experiments were begun in 1915. Since 1924 the subject has been studied by Dickenson, Tapsell, Baumann, Batson, and others, and investigations on creep at high temperatures are being made at the National Physical Laboratory and at the works of the Metropolitan-Vickers Electrical and Manufacturing Co., Ltd. It was with the researches by this company the authors were mainly concerned, and in this paper they gave the results of many tests, some of them lasting over thousands of hours, discussed the various phenomena observed in materials subject to stress at high temperature, described the plant and instruments used, and made suggestions as to the tests which should be required by the manufacturers. The paper is fully illustrated with curves, diagrams, and photographs.

### Astronomical Topics

**The Reinmuth Object**—Drs. Whipple and Cunningham found a parabolic orbit for this object. Dr. Stracke gives the following elliptical orbit from observations on April 24, 27, and May 1 (*Reich Inst Circ* 604):

|          |                       |
|----------|-----------------------|
| $T$      | 1932 July 8 9999 U T  |
| $\omega$ | $284^\circ 36' 05''$  |
| $\Omega$ | $35^\circ 54' 38.5''$ |
| $i$      | $5^\circ 53' 35.4''$  |
| $\phi$   | $31^\circ 52' 33.2''$ |
| $\log q$ | 9.8216414             |
| Period   | 1.6659463 years       |

This orbit satisfies the following observation by Dr. W. H. Steavenson within about  $3''$ , the discordance of the parabolic orbit is considerably greater.

May 6<sup>d</sup> 0<sup>h</sup> 27<sup>m</sup> 3<sup>s</sup> U T, R. A. (1932.0) 12<sup>h</sup> 31<sup>m</sup> 29<sup>s</sup>,  
S. Decl.  $11^\circ 2' 68''$

There is also the fact that the parallactic shift in R. A. between two Heidelberg positions on April 24 is  $23''$  by observation,  $20''$  as calculated from the ellipse, and  $10''$  from the parabola. There are therefore good grounds for supposing that the ellipse is nearer to the truth. If so, the object is still more remarkable than the Delporte planet. Its perihelion point is inside the orbit of Venus, and it passes within about 3 million miles of the earth's orbit at two different points. Its period is only half that of Encke's comet, so that even as a comet it would be remarkable, but its aspect appears to be quite stellar. Observations are urgently needed, as the object will be lost in the twilight before long. Dr. Stracke gives the following ephemeris for 0<sup>h</sup>

|        | R. A.                                         | S. Dec.           | $r$   | $\Delta$ |
|--------|-----------------------------------------------|-------------------|-------|----------|
| May 14 | 9 <sup>h</sup> 48 <sup>m</sup> 1 <sup>s</sup> | 9 <sup>°</sup> 2' |       |          |
| 15     | 9 21 1                                        | 7 25              | 1.015 | 0.070    |
| 16     | 8 54 0                                        | 6 26              |       |          |
| 17     | 8 27 7                                        | 5 22              | 0.997 | 0.072    |
| 18     | 8 2 8                                         | 4 18              |       |          |
| 19     | 7 39 7                                        | 3 15              | 0.978 | 0.077    |

The nearest approach to the earth,  $6\frac{1}{2}$  million miles, is on May 15.

**A New Kind of Eclipse Map**—*Monthly Notices* of the Royal Astronomical Society for March has a map of a novel kind to illustrate the eclipse of Aug. 31 next. Prof. S. Chapman contributes a paper on the influence of a solar eclipse on the ionisation of the upper atmosphere. It is important to use the coming eclipse to test the theory that the lower ionised layer in the atmosphere, the height of which is stated to be about 100 km, is ionised by neutral corpuscles emitted by the sun. Since these corpuscles travel much more slowly than light, the region of the earth that is affected by them differs considerably from the region of optical eclipse. Also, the screening is shown to be efficient over a region of the earth much larger than the zone of totality, in fact, it is nearly as large as the region of partial eclipse. It is shown that the axis of the shadow cylinder of the corpuscles will strike the earth two hours earlier than the optical shadow-cone, and that the British Isles and western Europe enjoy corpuscular eclipse, though they are outside the optical shadow. The map was drawn by Mr. J. C. P. Miller, at Prof. Chapman's request. It brings out the curious fact that a small portion of the track of optical totality is outside the region of corpuscular eclipse.

### Conditions of Air in Tunnels\*

ADEQUATE ventilation of tunnels assumes a fresh importance when a continuous stream of vehicles driven by internal combustion engines and coal-fired steam waggons is passing through them. From the progress of such vehicles in the tunnel products objectionable to health may arise, such as carbon monoxide and suspended sooty matter from incomplete combustion, moisture from the combustion of hydrocarbons, sulphur, for the most part, from coal, and lead from petrol treated with lead ethyl. A report on the actual condition of the air in two of London's tunnels is consequently of interest.

The condition of the air in the tunnels at Blackwall and Rotherhithe has been the subject of study by the chemical staff of the London County Council, determinations of carbon monoxide, suspended matter, and the relative humidity having been made during a period of nearly two years. In addition, determinations of the sulphur impurities were made from time to time by members of the staff of the Government Chemist, using the methods recently devised for the Committee on Atmospheric Pollution.

Under normal conditions of traffic, the highest concentration of carbon monoxide found in these tunnels was 3.1 parts in 10,000 of air, but on the occasion of a severe traffic block caused by an accident at Blackwall a value as high as 11.5 parts in 10,000 was obtained. It is noteworthy that the highest concentration of carbon monoxide found by workers in the United States in the New Jersey tunnel was 8 parts in 10,000, and that the average values were between 3 and 4 parts in 10,000. Further, the maximum concentration of carbon monoxide found by the Ethyl Petrol Committee in traffic blocks in the streets of London was 1.7 part in 10,000.

During the period covered by the tests, extraction fans were installed at one position at Blackwall, whereupon an improvement in the condition of the air at that place was observed. From the work of Haldane, Douglas, and Hartridge in Great Britain and of Henderson and his co-workers in the United States, it may be concluded that no appreciable physiological effect is produced by carbon monoxide in concentrations not exceeding 3 parts in 10,000 of air when breathed for 1 hour. Mr. Regan recommends, there-

\* London County Council. Annual Report of the Council, 1930 Vol. 4 (Part 3). Public Health. Medical Supplement to the Report on the Hospital Services. Page 271. The Ventilation of Vehicular Tunnels with Particular Reference to those at Blackwall and Rotherhithe. By C. J. Regan.

fore, that the proportion of carbon monoxide in the air of the tunnels should not be allowed to exceed 2 parts in 10,000.

Suspended matter determined by the Owens portable air filter was indicated by 12 fog-shade units as a highest value under normal conditions of traffic at both Blackwall and Rotherhithe, each fog-shade unit representing 0.32 milligrams of black suspended matter in a cubic metre of air, while a reading above 10 indicates a dense fog. It is recommended that the maximum permissible reading for black suspended matter should be 6 fog-shade units.

Since at no time did the relative humidity of the air in the tunnels approach 100 per cent, the fogs observed from time to time were smoke fogs, not water-vapour fogs. It was found, too, that when the average daily temperature outside the tunnels was above 58° F. the average humidity in the tunnels was above that of the outside air. Usually, however, the reverse was the case.

The average quantities of sulphur dioxide found at Blackwall and Rotherhithe were 0.26 and 0.51 parts per million, respectively. These values, while not being excessive, are somewhat higher than the average figures, namely, about 0.13 parts per million, for the air of London given on page 48 of the seventeenth report (for the year ended March 31, 1931) of the Committee on Atmospheric Pollution.

The possibility that the air in the tunnels might contain lead was not overlooked, but no experimental work has been carried out up to the present time. It is fortunate that there is available in the results obtained by the Ethyl Petrol Committee a datum line for the quantity of lead occurring in the dust of the streets of London. On the average the settled dust of the streets contains 0.35 per cent of lead. If, therefore, the air of the tunnels were to become polluted with lead owing to an increase in the use by motor vehicles of leaded petrol, it is to be expected that the proportion of lead then found in the air would be greatly in excess of this value.

As a result of the investigation it is concluded that the atmospheric conditions in the tunnels are worst about 10 A.M., that they are worse in summer than in winter, and particularly when the temperature of the outside air rises above that of the tunnels. Additions to the ventilating plant at both tunnels are being made, and those at Blackwall are well advanced towards completion. A. G. F.

### Nutrient Salts in the Mediterranean

THE well-known sterility of the Mediterranean Sea compared with the neighbouring waters of the Atlantic Ocean finds a ready explanation in the chemical investigations carried out on board the Danish research vessel *Dana* by Helge Thomsen in the summer of 1930\*. Determinations were made at all depths at stations in the southern Mediterranean of the nutrient salts, phosphate and nitrate, known to be essential for the growth and reproduction of the phytoplankton, which in turn form the foodstuff, directly or indirectly, of almost all other life in the sea. The results are striking.

In the Mediterranean the concentrations of both salts are much less than in the great oceans of the

world at similar depths. In depths greater than 200 metres the maximum nitrate content is everywhere 3-4 times greater in the Indian and Pacific Oceans and 2-4 times greater in the Atlantic than in the Mediterranean. For the minimum values the corresponding ratios are very high (of the order 8-23) in depths between 200 metres and 600 metres in accordance with the very low minimum values in the Mediterranean. Further, below 400 metres depth the maximum values for both phosphate and nitrate in the Mediterranean are less than the minimum values in the oceans.

In the surface waters, interpretation of the very low results found is more difficult, since so much of the work both in the Mediterranean and in the oceans in higher latitudes has had to be done in summer, when the salts could conceivably have been depleted by a preceding spring outburst of diatom growth. The region of complete depletion (less than 5 mgm. phos-

\* "Nitrate and Phosphate Contents of Mediterranean Water." Report on the Danish Oceanographical Expeditions, 1908-10, to the Mediterranean and Adjacent Seas vol. 3, *Miscellaneous Papers*, No. 6, pp. 14. Copenhagen, 1931.

phate ( $P_2O_5$ ) or 10 mgm nitrate nitrogen per cubic metre) usually extended down to 150-200 metres, and in this connexion red algæ have been found growing in this sea down to 130 metres, far below the limit to which sufficient light could penetrate in the more turbid northern waters † Thus it would seem that the very scarcity of nourishment and resulting sparseness of sub-surface life enables light to penetrate far into the water for plants there to utilise the minute quantities of phosphate and nitrate which diffuse up from the meagre bottom store. Perhaps indeed, in the Mediterranean the region most favourable for planktonic organisms may be far removed from the surface, at, say, 100 metres, where a sufficiency both of light and of nutrient salts are found together. This is far lower than is found anywhere in waters around Great Britain. Experimental data on the amount and quality of the light penetrating to such depths and of its suitability for photosynthesis should prove illuminating.

† Harvey, H. W., "Biological Chemistry and Physics of Sea Water" Cambridge, 1928.

The concentrations of both phosphate and nitrate decrease going eastward from the Straits of Gibraltar. In the Aegean Sea phosphates were not detected at any depth, and nitrates were very poor. It is manifest that life cannot flourish on any considerable scale in such impoverished waters. In the Straits of Messina nitrate appeared to be comparatively high, apparently due to vertical mixing, but it was unaccompanied by phosphate and was presumably therefore of little value.

The scarcity of nutrient salts in the Mediterranean is attributed by Thomsen to the exchange of water through the Straits of Gibraltar, since Atlantic surface water, already poor in nitrate and phosphate, runs in over the outgoing bottom current of Mediterranean water. This exchange of water has been well established by several vessels, including the *Dana*, and Thomsen's own analyses in the Straits and the Alboran Sea testify to the impoverishment of the inflowing Atlantic surface water, at any rate in April and June.

L. H. N. C.

### Acoustic and Telephone Measurements

IN a paper read by H. R. Harbottle to the Institution of Electrical Engineers on April 8, a brief description is given of some of the work carried out in the research section of the British Post Office. He begins by discussing electro-acoustic and acousto-electric measurements of instruments. He next describes voice-ear measurements on microphones and receivers, and finally deals with mechanical tests by means of which rapid acceptance tests can be made and estimates given of the commercial life of instruments.

Mr Harbottle attributes the progress made during recent years to the methods invented of expressing the results of measurements in telephony by reference to absolute units. These methods followed on the invention and development of the thermionic valve. This has enabled acoustic pressures and velocities to be measured accurately, and has led to the rapid advances made in radio-telephony. This in turn has promoted world-wide telephonic communication.

To enable this to be done, an international committee had to be formed, called the C. C. I.—Comité Consultatif International des Communications Téléphoniques à grande distance—the objects of which were the formulation of correct methods of measurement. Standard instruments were required which had to give a constant response over the range at which they were used. At the present time this can only be achieved by the use of insensitive instruments in which the mechanical resonances have been removed outside the working range by increasing or diminishing the stiffness. The output is then raised by a thermionic valve amplifier suitably applied. A wide field has been found for these instruments in broadcasting, sound pictures, and gramophone reproduction.

The instrument used at the present time as a work-

ing standard in most acousto-electric and electro-acoustic measurements is a condenser microphone. It consists of a thin aluminium diaphragm, gold-plated to prevent oxidation, forming one plate of the condenser, the other being a circular insulated brass electrode. This is grooved, and is fixed at a small distance away from the other plate. The space between them is practically sealed, and so adds 'stiffness' to the diaphragm. Due to this, the frequency of natural resonance is effectively suppressed.

The microphone is polarised by applying 200 volts across it. Its vibrations cause variations in the capacitance, and consequently it acts like a generator producing electric currents. It is calibrated by one of three methods—the thermophone method, recommended by the C. C. I., the Rayleigh disc method, or the compensator method. The results obtained by these methods have been found by the Post Office to agree satisfactorily.

By means of an automatic device the life test of a carbon microphone can be reduced to about one-fiftieth of the normal time taken. A current is first switched on—this represents the lifting of the receiver from the switch hook. A klaxon is next operated momentarily—this simulates the removal of the receiver by the subscriber. 7.5 seconds later the microphone is subjected to a rhythmic 'howl-warble' tone for 7.5 seconds, and this tone is repeated seven times at intervals of 7.5 seconds. At the end of 1½ minutes the klaxon is momentarily operated and the current switched off. There is then an interval of 1.5 minutes and the cycle begins again. In a week's time the wear on the telephone is the same as that made by a subscriber who in a year makes a thousand calls.

### South Sandwich Islands\*

THE first of the two *Discovery* Reports before us is the list of stations 137 to 433 made by R. R. S. William Scoresby in the seas between South Georgia, the Falkland Islands, and the South Shetlands from January 1928 to May 1929, and other stations made

by members of the *Discovery* investigations staff from whale factory ships about the South Sandwich Islands and in the Ross Sea. This follows the first station list published in an earlier volume of the *Discovery* Reports.

The second report under notice deals with the South Sandwich Islands. These islands were discovered by Cook in 1775 and Bellingshausen in 1819, but they lie in stormy and frequently ice-invested seas off the track of most antarctic expeditions, and have been rarely visited except by sealers and whalers until the *Discovery* spent twenty days among the group in

\* *Discovery* Reports. Issued by the *Discovery* Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Vol. 3. Station List, 1927-1929. Pp. 132+10 plates 14s 6d net. The South Sandwich Islands. By Dr Stanley Kemp and A. L. Nelson, with a Report on Rock Specimens, by Dr G. W. Tyrrell. Pp. 133-198+plates 11-31. 18s net. (Cambridge At the University Press, 1931.)

February and March 1930 The eleven islands, extending in a chain of 193 miles, are all small and volcanic The largest has a circumference of only twenty-four miles Landing is always difficult and on some islands perhaps impossible Sulphurous fumes in places are a menace The *Discovery* found no active volcanic eruptions, though five islands were emitting vapours and fumes There were indications that volcanic activity is abating, and three islands show no recent signs of it The rocks collected were all typical Andean lavas, as described by Dr Tyrrell, and confirm Suess's theory of a South Antillean arc The conspicuous 'deep' to the east, sinking to 4421 fathoms, is another noteworthy feature The only possibility of sedimentary rocks in the whole group appears to be in Freezeland Peak on Bristol Island but no landing was achieved there Some of the islands have ice-caps others have foreland glaciers Vegetation seems to be confined to a few lichens and algae No flowering plants were seen Fur seals were not found, though they probably occurred in the past The volume contains maps and photographs of all the islands, and also an Admiralty chart of the group It is a fairly complete monograph on the islands

R N R B.

### University and Educational Intelligence

CAMBRIDGE—An election to an Isaac Newton Studentship will be held early in the Michaelmas Term, 1932 These studentships are for the furtherance of advanced study and research in astronomy and physical optics Members of the University are eligible who have obtained a degree in the University and were under the age of twenty-five years on Jan 1, 1932 failing such a candidate, a research student, subject to the same condition as to age, may be elected The studentship will be of the value of £250 a year, and will be tenable for three years Applications should be sent to the Vice-Chancellor between Oct 7 and 13, 1932

Candidates for the Michael Foster Studentship in physiology are requested to send their applications, with a statement of the course of research they propose to undertake, to Prof J Barcroft, Physiology School, before the end of June The student receives the annual value of the fund (about £100)

At Jesus College, Dr W H Thorpe has been elected a fellow He has been a research fellow of the Rockefeller Foundation at the University of California and a member of the research staff of the Imperial Institute of Entomology At St John's College, Dr L Rosenhead has been elected a fellow He entered the college with an Open Strathcona Research Studentship for mathematics, and in 1930 was elected a Senior Research Student of the Royal Exhibition of 1851

LONDON—Applications are invited for the Laura de Saliceto studentship for the advancement of cancer research, value £150 annually and tenable for not less than two years Applications should reach the Academic Registrar, University of London, South Kensington, S W 7, by July 1 at latest

OXFORD—The proposed regulations for the new Final Honour School of Geography are now published, and will be dealt with by Congregation in due course The stated subjects include physical and regional geography, cartography, the geography of man, and the history of geographical discovery In addition to these, a special subject may be offered The examination will be partly practical, and will include laboratory and field work Candidates will be required to show sufficient knowledge of French or German and of the elements of physics and biology

READING—Dr William B Brierley, since 1918 head of the Department of Mycology in the Institute of Plant Pathology at the Rothamsted Experimental Station, has been appointed professor of agricultural botany in succession to Prof J Percival, who is retiring next September

THE usual summer vacation course for teachers will be held at Bingley Training College, Yorks, on July 27–Aug 10 Among the courses available are one on biology by Prof R Douglas Laurie, professor of zoology, University College, Aberystwyth, and another on the senior school, by Sir Percy Nunn, director of the University of London Institute of Education Application should be submitted not later than June, while grants-in-aid applications must reach the Education Officer, County Hall, Wakefield, not later than May 31

THE University of Cambridge publishes annually abstracts of dissertations approved for its Ph D, M Sc, and M Litt degrees (Cambridge At the University Press, 1932) These summaries, each of which has been approved by the examiners or supervisor of studies, afford a convenient index to the scope of recent advanced study and research in the University The sixty-one dissertations for the year 1930–31 are distributed among the faculties as follows Physics and chemistry 24, biology 11, mathematics 8, agriculture 4, engineering 3, archaeology and anthropology 2, history 2, geography, medicine, music, moral science, economics, English, and classics one each Thirty-eight of the candidates had previously studied in other universities, namely Liverpool 5, Wales 4, Scottish universities 4, other universities in the British Isles 4, universities in Canada, South Africa, Australia, and New Zealand 11, in India 7, in the United States of America 2, Switzerland 1

COMMERCIAL education in the United States is reviewed in *Bulletin* No 20, 1931, of the Office of Education, Washington, being advance pages of the official Biennial Survey (1928–30) of Education in the United States Few people have any idea of the enormous amount of time and energy devoted in the United States to commercial education and to the investigation and discussion of the principles and methods employed in this field in secondary schools and universities More than a million young men and women are enrolled in business courses, exceeding the number in any field of vocational training, and during the past ten years there was an increase of more than three hundred per cent in such enrolments in colleges and universities At this rate the schools of commerce will soon be throughout the States, as they are already in many institutions, the largest of the professional and vocational university schools At the Congress of Universities of the British Empire, held at Edinburgh last July, the subject of commercial education figured prominently, and reference was made to the resistance of British universities to the dangers of being stampeded into endeavouring to make university education more 'practical', with the deplorable results experienced in American universities This bulletin recounts facts which tend to discount the force of this criticism and show that we have something to learn not only from their mistakes but also from their thoroughgoing investigation of principles and methods The bulletin contains summaries of the results of these and other investigations, and will, doubtless, be in request at the International Conference on Commercial Education to be held in London this year It is obtainable, price 10 cents, from the Superintendent of Documents, Government Printing Office, Washington, D C



## Calendar of Geographical Exploration

May 18 (or 20), 1499 — Amerigo Vespucci

Alonso de Ojeda sailed from Cadiz, with Amerigo Vespucci on board one of his vessels. Vespucci was a contractor for ship's provisions, and did not, apparently, go to sea until he was more than forty years of age. He claimed to have made four voyages to the New World, in 1497, 1499, 1501, and 1503. The first and third voyages are rejected by many, but not all, students. However this may be, there is no doubt that Vespucci went with Ojeda on his voyage, though the two men were not on the same boat, Ojeda reaching the coast of America near Surinam and proceeding to Maracaibo, while Vespucci reached it in 5° S, roughly. In his third voyage, Vespucci claims to have sailed along the east coast of South America from 5° to 50° S, a voyage which, if genuine, gives him a high place in exploration. According to Vespucci's own statement, he had on his first voyage reached the mainland on June 16, 1497, namely, 8 days before John Cabot. The name America appears to have resulted from a copy of Vespucci's letter about this voyage reaching the professor of cosmography at St. Dié University (Lorraine), who suggested in his "Cosmographiæ Introductio" (1507) that the newly discovered land should be called "America, because Americus discovered it."

May 19, 1845 — Sir John Franklin

Sir John Franklin left England for Cape Walker, whence he hoped to reach Bering Strait. He wintered on Beechey Island, and next summer proceeded southward down Peel Sound, spending the second winter in 70° 5' N, 98° 23' W, on the pack ice, where the ships were held fast all through the summer of 1847. Franklin died on June 11, 1847; the party deserted the ships in April 1848, and tried to penetrate south by land, but all perished. The numerous parties organised to try to obtain information about Franklin's fate resulted in great additions to geographical knowledge of the American arctic. News of Franklin's fate was first obtained from Eskimo in 1851, and in 1859, Hobson, a member of McClintock's expedition, found a sheet of paper on King William Island recording briefly what had happened up to the attempt to escape overland. Franklin's first arctic voyage was undertaken in 1818, when he was in charge of one of the vessels in Buchan's expedition. In 1819 he was leader of an expedition which resulted in the charting of much of the unknown coast-line of North America and occupied three years. This and a further journey in 1826 added 1200 miles of coast-line to the map of arctic America. From 1836 until 1843 he was lieutenant-governor of Tasmania (van Diemen's Land). Renewed interest in the polar regions at the time of his return to England led to his last and tragic journey.

## Societies and Academies

## LONDON

Royal Society, May 5 — A. V. Hill. A closer analysis of the heat production of nerve. The heat production of nerve is believed to occur in two phases, 'initial' and 'recovery'; the former is presumably an accompaniment of the physical and chemical changes which take place during the propagation of the impulse, the latter, of the processes by which those changes are reversed and the nerve restored to its initial state. It is not easy to separate the one from the other. The possibility that the initial heat is due to phosphagen

breakdown or lactic acid formation is discussed; the quantities available are sufficient — H. E. Roaf. The influence of coloured surrounds and coloured backgrounds on visual thresholds. Exposure of the retina to light raises the differential threshold. For the fovea, the chief influence in raising the threshold is the simultaneous exposure to light, and for the parts of the retina outside the fovea there is considerable spread of effect from one part of the retina to another. The influence of wave-length on the results is very striking with foveal vision, as 'red' light raises the threshold for all parts of the spectrum, but 'green' and 'blue' lights have a negligible effect on the long wavelength end of the spectrum — N. Gavrilescu, A. P. Meiklejohn, R. Passmore, and R. A. Peters. Carbohydrate metabolism in birds. The site of the biochemical lesion in avian polyneuritis. Oxygen uptakes of normal and avitaminous birds have been measured. The results suggest that vitamin B<sub>1</sub> deficiency is connected essentially with the intermediary metabolism of carbohydrate.

Geological Society, March 23 — William S. Boulton. The rocks between the Carboniferous and Trias in the Birmingham district. The succession at Wyndors Street Gas Works in east Birmingham is continuous to a depth of more than 1000 feet, and includes the Bunter (with a basal breccia), the Nechells breccia, and part of the calcareous conglomerate group. The content of the breccias and conglomerates was described, and a graph was given showing the percentage distribution of rock types at different depths. The heavy mineral residues of the associated sandstones have also been determined. The Barr Beacon beds underlying the Bunter Pebble beds, mapped by the Geological Survey as Hopwas breccia, are of Bunter age, and with them were correlated the breccias at Tower Hill, near Hamstead, and also the more extensive beds of sand-rock at the base of the Bunter of Cannock Chase. The breccias of Hopwas, Sutton Park, Warley, Northfield, and the Lickey, though discontinuous deposits, are of the same general age, and have all been derived from highlands to the immediate east and south, the outcrops of which mainly consisted of Uriconian felsite- and andesite-tuffs and lavas, and basalts. Extensive and prolonged erosion accompanied and followed the Hercynian earth-movements in the area.

## LEEDS

Philosophical and Literary Society, March 1 — E. C. Stoner. The correlation of the gyromagnetic ratio and the magnetic moment of paramagnetic salts. The observed magnetic moments and gyromagnetic ratios are compatible with each other, and may be accounted for by considering the interaction between the spin and orbital moments of one ion and the interaction of the ion with its surroundings — G. W. Brindley. On the refraction of X-rays by perfect crystals. If the *atomformfaktor*  $f$  is incorporated in Ewald's treatment of the reflection of X-rays by perfect crystals in the way suggested by Darwin's earlier treatment of the subject, then the refractive indices of calcite for X-rays calculated from the observed widths of reflections are in good agreement with values obtained in other ways. The agreement is not good if the *atomformfaktor* is omitted — E. C. Pollard. Nature of the potential barrier of the nitrogen nucleus. Experiments have been carried out on the variation of the yield of protons produced by fast  $\alpha$ -particles from nitrogen as the energy of the impinging particle is reduced, the aim being to determine whether the  $\alpha$ -particle enters the nucleus by resonance or by scaling the potential barrier. The results appear to show that resonance does not occur, entry is over the

top, and an approximate estimate of the height of the nuclear barrier is given—H M Dawson and W Lowson. The catalytic effect of acids on the rate of ester hydrolysis in relation to the ester concentration and the nature of the acid. The nature of the process which is involved in the acid catalysed hydrolysis of ethyl acetate is discussed and consideration given to the conditions under which the velocity of the reaction may be used as a measure of hydrogen ion concentration. A comparison of the catalytic effects produced by hydrochloric, chloro-acetic, glycolic, and acetic acids at ester concentrations ranging from 10 cc to 60 cc ester per litre shows that the ionisation constants of the weak acids decrease continuously as the ester concentration increases. Extrapolation to zero ester concentration is necessary if strictly comparable values are to be obtained—C H Douglas Clark. Spectroscopy and valency. (1) The periodic groups of atoms and ions. The classification previously proposed for atoms in ground states has been extended to the rare earth elements, to inert gas-like ions, and to ions of transition elements. The electron groups  $s^2$ ,  $p^2$ ,  $d^{10}$ , and  $f^{14}$  tend to show central symmetry in respect of electron spins in ground states, with maximum valencies and maximum possibility of variable valencies near the centres of the groups, whilst departures from central symmetry are accompanied by the appearance of irregularities in valency. Such departures afford interpretation of the anomalous valencies of transition elements. The evidence of ionisation serves to confirm the views put forward—N. Gill. The phloem of ash, *Fraxinus excelsior* Linn., its differentiation and seasonal variation. Production of large sieve tubes, each usually having a single companion cell in transverse section, begins in spring and continues throughout the summer, being most vigorous when the leaves are fully expanded. Just before leaf fall a modified type of sieve tube is produced, and is characterised by a smaller transverse area and a larger proportion of cambiform companion cells. No further phloem is produced after leaf fall until the following spring.

## PARIS

Academy of Sciences, March 29—A Buhl. New integral invariances connected with differential equations containing several parameters—Émile Sevín. Concerning the energy of matter—Nicolas Kryloff and Nicolas Bogoluboff. The phenomena of demultiplication of frequency in radiotechnics—G Reboul. A particular mode of activation of matter—Rene Audubert and Mlle Cecile Stora. The photovoltaic properties of cadmium sulphide. The sensibility of cadmium sulphide with regard to various radiations of the visible spectrum has been determined, and the results given graphically. If photo-electronic phenomena intervene, they play only a secondary part—Maurice Billy and Mlle Irène San-Galli. A new method of investigation for the study of the hydrated peroxides—C T Popesco. The effects of a new system of grafting in *Lycium vulgare* placed on the tomato—Mlle Odette Tuzet. The centrols of the egg of the sea urchin, *Paracentrotus lividus*—Victor-Pauchet and A Becart. The gastro-photographic method and its automatic means of control.

## GENEVA

Society of Physics and Natural History, Feb 4—Arnold Pictet. Inheritance of polydactyly in the guinea-pig. Polydactyly arises from the union of two parents of a polydactyl strain. One of the parents contributes a factor of intensity, the other a factor of intensity in the heterozygote state together they contribute an additional common factor, the com-

binations of these three factors being indispensable for the creation of polydactyly. The polydactyls thus created may produce normal types indefinitely and the normal types produce polydactyls indefinitely—Charles Jung. The calculation of the ureo-secretory coefficient considering the two kidneys separately. The author shows that when the two kidneys work at different concentrations the ureo-secretory coefficient calculated from the total urine is incorrect. He gives an example where the error amounts to 13.8 per cent of the whole, calculated by adding the partial yields—A Schidlof and H Saini. An attempt at a theory of emission of the  $\beta$ -rays by radioactive nuclei. The new interpretation of the authors gives an explanation of the analogy which exists between the  $\alpha$ -rays and the  $\beta$ -rays, and makes clear the cause of the difference between the two classes of radiations—P Dive and R Wavre. The Newtonian potential and multiform functions. The authors show in a very curious example the precautions which should be taken when prolonging analytically an ordinary potential, according to the nature of the topological data—Léon Collet and Ed Paréjas. Results of the geological expedition of Harvard University in the Canadian Rockies (Jasper National Park), 1929. (4) The geological section along Mural Glacier and the thrust plane of the Mumm Peak nappe. The authors give the detailed succession of the terranes along Mural Glacier and determine the thrust plane of the Mumm Peak nappe on both sides of the glacier. Owing to this overthrust, Lower Cambrian with *Olenellus* overrides Upper Cambrian—(5) The geological section between Mount Robson and Moose Pass. The authors present the first complete geological section between Mount Robson and Moose Pass. On this section the thrust plane of the Mumm Peak nappe passes between the Chetang Ridge and the Tate Ridge. Few corrections have to be made to Walcott's section of Mount Robson.

## WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 18, No 1, Jan 15)—Charles P Winsor. The Gompertz curve as a growth curve. Benjamin Gompertz's curve (*Phil Trans.*, 1825) is compared with the logistic curve, the former seems to give a good fit with material showing an inflection when about 37 per cent of total growth is completed, whereas the latter has its point of inflection about midway between the asymptotes—Wilder D Bancroft, Robert S Gutsell, and John E Rutzler, jr. Reversible coagulation in living tissue. (10) Morphine was withdrawn gradually from a drug addict of long-standing, giving large doses of sodium rhodanate. There were no major withdrawal symptoms. The sodium salt rapidly peptises protein colloids agglomerated by morphine, and also seems to assist in eliminating morphine from the tissue—Harlow Shapley, Ernst J Opik, and Samuel L Boothroyd. The Arizona expedition for the study of meteors. The equipment consists of two huts, on the opposite slopes of the roofs of which are iron reticules to provide co-ordinates of reference for visual observations. The huts are 23 miles apart on an east-west line. Telescopic observations are being made at two stations 2 miles apart. Angular velocities are being observed by a 'double-pendulum apparatus' consisting of an oscillating plate-glass mirror—Howard Sprague Reed. The growth of *Scenedesmus acutus*. Growth of this alga followed the sigmoid curve of autocatalysis except for an initial lag—H E Dolk and K V Thimann. Studies on the growth hormone of plants. (1) The technique of preparing this hormone in quantity from mold cultures is described. Its activity was tested on the

coleoptiles of oats and a unit is suggested. The hormone appears to be an acid which is readily oxidised. A method of purification is described.—Warren W. Wilcox. The basis of the dependence of visual acuity on illumination. Acuity was measured by observing the separation of two parallel bars. For bright bars on a dark ground, acuity first falls with increased illumination, passes through a minimum and then rises. For dark bars on a bright background, acuity decreases with increasing illumination, the rate of decrease becoming progressively less. It is concluded that irradiation, or apparent shift of contours, is the only cause of the variations of visual acuity with intensity. Hecht's theory of a variation in the number of functional retinal elements is unnecessary.—Henry Margenau. Quantum dynamical correction for the equation of state of real gases. London has suggested that the deviations of light gases such as hydrogen and helium from the perfect gas law may be due to the existence of zero point energy associated with the vibratory motion of molecules in quantised collision states rendering the attractive Van der Waals' forces partially ineffective. This problem is investigated quantitatively.—William Duane. New lines in the K-series of X-rays.—Hassler Whitney. Note on Perron's solution of the Dirichlet problem.—J. v. Neumann. Proof of the quasi-ergodic hypothesis.—Jesse Douglas. Seven theorems in the problem of Plateau.—A. W. Tucker. On combinatorial topology.—W. Seidel and S. B. Littauer. Lines of Julia of integral functions.—Eberhard Hopf. On the time average theorem in dynamics.—G. A. Miller. Sets of distinct group operators involving all the products but not all the squares.—Tracy Yerkles Thomas. Conformal tensors (I).—D. V. Widder. On the changes of sign of the derivatives of a function defined by a Laplace integral.—Arthur L. Fox. The relationship between chemical constitution and taste. Phenyl thio carbamide and related substances are bitter in taste to some people and not to others. The taste of these compounds is associated with a C=S linkage (see also NATURE, 128, 124, July 18, 1931).—Albert F. Blakeslee. Genetics of sensory thresholds: taste for phenyl thio carbamide. Inability to taste this compound is inherited as a Mendelian recessive. From experiments using different strengths of solutions, it was found that innate differences exist as regards threshold value, the strength of the sensory reactions, and the ability to detect differences of concentration and to discriminate between different substances.—Harold H. Plough. Elimination of self-sterility in the *Styela* egg—a reinterpretation with further experiments. The author stated in an earlier paper that self-sterility was eliminated due to the addition of ammonia or caustic soda to sea-water containing the eggs. This is incorrect, the effective factor is time. On standing in sea-water, eggs and sperm undergo a spontaneous change which removes the block to self-fertilisation.—T. Cunliffe Barnes. The physiological effect of trihydrol in water. Water containing large quantities of the trihydrol form of water causes much increased rate of growth of *Spargyr*, it is suggested that the colloidal trihydrol aggregates are the first steps in the formation of carbohydrates (see also NATURE, 129, 691, May 7, 1932).

## VIENNA

Academy of Sciences, Jan. 28.—Otto Porsch. The bat-flower problem. A number of species are added to the list of flowers fertilised by bats.—Adolf Franke, Alfred Kroupa, and Theodora Panzer. Ring contraction in the formation of internal ethers (oxides) from glycols. In continuation of the investigation of the action of sulphuric acid on higher glycols, it is found that tetradecan-1, 14-diol also yields an internal

ether, 1, 5-oxidotetradecane.—Robert Sandri. Diffusion and transport of gases in liquids. (2) Diffusion of hydrogen through colloidal and liquid membranes. When a narrow gas-filled tube is closed at one end with a long drop of water and at the other with a thin membrane (rubber), diffusion of the gas and air through the membrane forces the water in one direction or the other. Quantitative investigation of this phenomenon yields results in approximate agreement with Fick's theory of diffusion and with Henry's law.—Wilhelm Petraschek. Comparative studies of deposits—the magnesites and siderites of the Alps.—Alexander Tornquist. An ore-deposit of the Raibl-Bleiberg type in the Dolomites.—Leopold Kolbl. The north-east end of the Grossvenedig mountain group.—K. Graff. Night measurements of the transmissivity coefficients of the atmosphere in Mallorca in winter. Determinations of the transparency coefficient of the atmosphere at night by measuring the brightness of stars at different distances from the zenith yielded surprisingly high values, 23 out of 38 exceeding 0.85, or, allowing for the barometric height, 0.881. These values are distinctly greater than those obtained in Santis and Etna, which are both between 2500 metres and 3000 metres above sea-level.—K. Graff. Distribution of brightness in the sky at full moon. Except in the immediate neighbourhood of the full moon, the relative brightness of the night sky was found to vary only from 1 at the zenith to 0.4 in the polar region.—Michael Radaković. Raman effect. (17) The possible distributions of forces in the mechanical model of a triatomic molecule.—Rudolf Scharfetter. Vegetational relationships of the Gerlitzen in Carinthia.—Viktor Lebzelter. Individual growth in the Koisian race group.—Josef Hoffmann. Behaviour of alkali glasses containing chlorine, fluorine, and sulphate ions, and of manganese glasses, with and without iron, towards  $\beta$ - and  $\gamma$ -radiation. Experimental results confirm the previous conclusion that, with silicate glasses, blue and violet radiation colours are not produced by alkali metal atoms. In manganese glasses, red radiation colours are attributable to Mn ions and violet colours to the simultaneous presence of Mn and Mn ions. The latter alone give no colour, but in combination with iron a grey colour.—Karl Przibram. An empirical rule concerning the behaviour of certain plastic bodies towards pressure.—Stefan Meyer. Proton numbers, atomic numbers, and range of  $\alpha$ -radiators. The range of  $\alpha$ -radiators is given approximately by the expression,  $\log R_0 = \log D + 0.60 - 0.043(P - 223)$ , where  $P$  is the proton number and  $D$  is a function of the atomic number which varies periodically with the cube-root of the reciprocal atomic volume. A property of the nucleus, apparently connected with the periodic behaviour of the shell electrons, is also deduced.

Feb. 4.—Anton Schedler and Max Toperczer. Distribution of the geomagnetic declination in Austria at the epoch 1930.0.—Max Toperczer. The measurement of the magnetic declination with magnets suspended by threads. The corrections rendered necessary in applying this method of measuring magnetic declination, owing to the influence of torsion in combination with the imperfect character of the suspension, are considered. Measurements with two magnets being only just sufficient to eliminate the disturbing influences, the use of a greater number (at least three) of magnets is proposed.—A. Dadiou, K. W. F. Kohlrausch, and A. Pongratz. Studies on the Raman effect. (18) Raman spectrum of organic substances (polysubstituted benzenes). (1) Experiments with the six isomeric xylydines and xylenols show that the spectral type is determined by the position of the substituents and not by their nature. The spectra

may be classified in three groups according to the positions of the radicles introduced (1) symmetrical, 1 3 5, (2) vicinal, 1 2 6 or 1 2 3, and (3) unsymmetrical. Only in case (1) does the principal benzene line ( $\Delta\nu=990$ ) appear with marked intensity, and as the symmetry of the nucleus vibration with the 1 3 5-compound can be only trigonal, it is concluded that the symmetry of the ring itself is also trigonal—Alfred Brukl and Bruno Hahn. The heteropoly-acids of germanium.

### Forthcoming Events

#### FRIDAY, MAY 13

- ROYAL ANTHROPOLOGICAL INSTITUTE (Sociological Research Committee), at 5 30—J H Driberg Economic Stages of Development in Africa  
 ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5 30—Annual General Meeting  
 BRITISH ASSOCIATION OF CHEMISTS (London Section) (at Broad Street Station Restaurant, E C), at 7—Annual General Meeting  
 INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Cowdray Hall, Aberdeen), at 7 30—Prof J K Catterson-Smith Everyday Uses of Electricity (Faraday Lecture)  
 ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Sir John C W Reith Broadcasting  
 INTERNATIONAL COMMITTEE ON THE HISTORY OF SCIENCE (at Paris) (continued on May 14 to 16)

#### SATURDAY, MAY 14

- ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS (Annual Conference) (at Technical College, Cardiff) (continued on May 15 to 17)

#### TUESDAY, MAY 17

- ROYAL SOCIETY OF MEDICINE, at 5—Special Meeting of Fellows  
 KING'S COLLEGE, LONDON, at 5 30—Prof M Schlick Form and Content (Succeeding Lectures on May 18 and 20)  
 IRON AND STEEL INSTITUTE (Additional Meeting) (at Royal Metal Exchange, Swansea), at 6—Presentation of Papers

#### WEDNESDAY, MAY 18

- NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (at London School of Economics), at 5 30—Dr C S Myers Psychological and Social Factors in Business Rationalisation (3) The Advantages of Rationalisation  
 INSTITUTION OF WATER ENGINEERS (at Sheffield)—Summer General Meeting (continued at Buxton, May 19 to 21)

#### THURSDAY, MAY 19

- UNIVERSITY COLLEGE, at 2 30—Sir Flinders Petrie Canaanite Civilisation (to be repeated on May 21, at 3, and on May 24, at 5 30)  
 LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5—Prof H Levy A Numerical Study of Differential Equations (Lecture)  
 ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5—Annual General Meeting  
 LIVERPOOL BIOLOGICAL SOCIETY (in Zoology Department, Liverpool University), at 5 30—Mrs C S Hodson Biological Advances and Eugenics (Lecture)  
 UNIVERSITY COLLEGE, at 5 30—Dr C S Myers The Absurdity of any Mind-Body Relation (Hobhouse Memorial Lecture)  
 CHEMICAL SOCIETY, at 8—Discussion on Some Aspects of Asymmetric Synthesis  
 ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8—Annual General Meeting  
 BRITISH INSTITUTE OF RADIOLOGY (Annual General Meeting), at 8—Dr J C Mottram On the Relationship of Beta and Gamma Radiation in the Treatment of Tumours, The Action of Radium on Blood Supply—The White Reaction

GERMAN OPHTHALMOLOGICAL SOCIETY (at Leipzig) (continued on May 20 and 21)

CONGRESS OF INTERNATIONAL ASSOCIATION FOR BRIDGE AND STRUCTURAL ENGINEERING (at Paris) (continued on May 20 to 25)

#### FRIDAY, MAY 20

- ROYAL SOCIETY OF MEDICINE (Physical Medicine Section), at 5 30—Annual General Meeting  
 ROYAL SOCIETY OF MEDICINE (Radiology Section), at 8 30—Annual General Meeting  
 ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Prof H E Armstrong Faraday at the Sign of the Hexagon Coal Colour and Constitution  
 INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Sedbury, Monmouthshire)—Summer Meeting (continued on May 21 to 23)

#### SATURDAY, MAY 21

- INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7 45—Annual General Meeting  
 GERMAN CONGRESS FOR PSYCHICAL HYGIENE (at Bonn)

### Official Publications Received

#### BRITISH

- The Scientific Proceedings of the Royal Dublin Society Vol 20 (N S). No 17 Report on the Recent Bog Flow at Glencullin, Co Mayo By A D Delap, A Farrington, R Lloyd Praeger and Louis B Smyth Pp 181-192 1s Vol 20 (N S), No 19 Electrical Properties of Oil-Water Emulsions, with special reference to the Structure of the Plasmatic Membrane II By Prof Henry H Dixon and Dr T A Bennet Clark Pp 211-226 1s (Dublin Hodges, Figgis and Co, London Williams and Norgate Ltd)  
 Agricultural Progress the Journal of the Agricultural Educators Association Vol 9, 1932 Pp 184 (Cambridge W Heffer and Sons Ltd) 5s net  
 Seale Hayne Agricultural College Department of Plant Pathology Eighth Annual Report for the Year ending September 30th, 1931 (Pamphlet No 37) Pp 25 (Newton Abbot)  
 Journal of the Indian Institute of Science Vol 15A, Part 1 Salt Stains on South Indian Hides and Skins By V N Patwardhan and M Subramana Sastry Pp 8+1 plate (Bangalore) 12 annas  
 India Meteorological Department Winds, Weather and Currents on the Coasts of India and the Laws of Storms Pp iii+51+18 plates (Calcutta Government of India Central Publication Branch) 2 6 rupees 4s 6d  
 Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 57 Infectious Exterotoxaemia (The So called Braxy-like Disease) of Sheep in Western Australia By H W Bennetts Pp 72 (Melbourne H J Green)

#### FOREIGN

- University of California Publications in American Archaeology and Ethnology Vol 33, No 1 The Western Kuksu Cult By E M Loeb Pp vi+137 (Berkeley, Calif., University of California Press, London Cambridge University Press) 1 50 dollars  
 Japanese Journal of Botany Transactions and Abstracts Vol 6, No 1 Pp v+137+26 (Tokyo National Research Council of Japan)  
 Rubber Research Institute of Malaya Planting Manual No 3 Plantation Sheet Rubber Manufacture By R O Bishop Pp iv+61 (Kuala Lumpur) 2 dollars  
 Smithsonian Miscellaneous Collections Vol 87, No 5 The Narrative of a Southern Cheyenne Woman By Truman Michelson (Publication 3140) Pp 13 Vol 87, No 3 Seth Eastman, the Master Painter of the North American Indian By David I Bushnell, Jr (Publication 3136) Pp 19+15 plates (Washington, D C Smithsonian Institution)  
 Japanese Journal of Astronomy and Geophysics Transactions and Abstracts, Vol 9, No 2 Pp ii+77 125+7 11 (Tokyo Nations Research Council of Japan)  
 Iowa Geological Survey Vol 34 Annual Report, 1928, with Accompanying Papers Pp viii+464 (Des Moines)  
 Proceedings of the United States National Museum Vol 80, Art 14 Upper Cretaceous Foraminifera from Trinidad By Joseph A Cushman and P W Jarvis (No 2914) Pp 60+16 plates Vol 80, Art 18 The Parasitic Habit in the Ducks, a Theoretical Consideration By Herbert Friedman (No 2918) Pp 7 (Washington, D C Government Printing Office)  
 U S Department of Agriculture Technical Bulletin No 299 Repellence to the Japanese Beetle of Extracts made from Plants immune to Attack By F W Metzger and D H Grunt Pp 22 (Washington, D C Government Printing Office) 5 cents

#### CATALOGUES

- Classified List of Second hand Scientific Instruments (No 101 Pp vi+58 (London C Baker)  
 B D H Reagents for Delicate Analysis and "Spot" Tests Pp iv+41 (London The British Drug Houses, Ltd)  
 Women Writers (Seventeenth Century to Present Day) Biographies and Autographs of Celebrated Women, Children's Books, Costume, Nursing etc (Catalogue 548) Pp 28 (London Francis Edwards, Ltd)  
 Industrial Thermometers, Hydrometers, Pressure Gauges (List No 579) Pp 52 (London C F Casella and Co, Ltd)



SATURDAY, MAY 21, 1932

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## Co-ordination of Government Grants for Research and Development

THE War brought about a recognition of the value and application of research in solving the many problems which arose during the continuance of the struggle. As is well known, Germany, both in government and commercial circles, had recognised the value of research work before the dawn of the present century. The years following the Armistice have furnished evidence that if the British Empire is to keep pace with its competitors it must make the fullest use of the scientific worker in dealing with the complicated questions of administration and development which confront it. It is of good augury that this fact is now appreciated both by the Government of Great Britain and those responsible for the Empire overseas, the subject having been discussed at the Conferences of Prime Ministers which have been held in London.

Omitting for the moment the wider issues of this matter, a brief survey may be made of the developments which have taken place in Great Britain. As a forerunner of newer bodies at present in existence here, the Development Fund was inaugurated in 1910. The objects of this fund were to provide assistance, after due inquiry, to agriculture, fisheries, forestry, and so forth, in the form of grants for education, research, and other development work. After the War other interests arose, some of them conflicting, though this was not appreciated at the time. Bodies such as the Empire Marketing Board, the Colonial Development Fund, and the Colonial and Middle Eastern Services were formed, whilst increased grants for various new purposes were made to the Ministry of Agriculture and to the University Grants Committee.

These newer bodies and the increased activities of the older Development Fund grew up piecemeal, with little co-ordination and in the absence of any carefully thought-out or balanced scheme. To such an extent has this proved the case that many scientific workers themselves have found it difficult to ascertain the proper body to consult in connexion with a piece of work they may have had in hand, whilst to the layman the multiplicity of bodies making grants and the trouble of discovering to which to apply has furnished proof, if proof were wanting, of the inadequacy of the methods in force. Attention was directed to this state of affairs in these columns so long ago as July 26, 1930.

Owing to the lack of unified control over the allocation of grants by the various bodies in existence, it became apparent that Parliament had very little voice in the matter. It was being asked by different bodies to make provision for carrying out objects which were seemingly substantially the same, though this was not evident in the Estimates presented to the House of Commons, nor was it easy to appreciate the position after a close study. For these reasons the matter has been investigated by the Estimates Committee of the House, of which Sir Vivian Henderson is chairman. The first report of this Committee has now been presented to Parliament, and was referred to in *NATURE* of April 16, p. 572. The Committee has confined itself to an examination of the estimates of the above-mentioned funds and services. The report is timely and will prove illuminating to the public, though it may present few surprises to those conversant with the position.

It has been difficult for research workers and others to discover in how far the various bodies receiving grants from Government have been cognisant with the work being undertaken by their confrères, but the Committee does not suggest that the bodies and departments allotting grants are in ignorance of the position. Nevertheless, the Committee has discovered that grants are being made by the Empire Marketing Board for many purposes which are also assisted by the Department of Scientific and Industrial Research, the Ministry of Agriculture, the Development Fund, and the Forestry Commission. Many institutions are receiving grants from the State through one or more, or even up to five or more, different sources. It is also apparent that grants are being made from the Colonial Development Fund for ordinary purposes of government in Colonies which are at the same time in receipt of a grant-in-aid from the Colonial Office. It has thus become apparent (1) that Parliament is not in a position to ascertain with ease the total assistance it is granting to one institution, (2) that the multiplicity of grants obtained by one institution from several different bodies results in a greater total being given than would be the case if the total sum were voted by Parliament itself in a single grant.

The Committee directs attention to the long-established canon of sound finance by which all government aid for any one purpose or any one body should be provided in a single grant. It is recognised that this ideal may often be unattainable; but the Committee considers that it is

essential, before this principle is departed from in any one case, to make sure that there are adequate grounds for so doing.

The Committee is therefore of opinion that, even if bodies and departments have extant elaborate arrangements for maintaining the essential co-ordination, the necessity for such arrangements appears to challenge the efficiency of the present system and to constitute a strong case for reviewing it. It therefore recommends that the Estimates should be so framed in future that the total State grant allocated to any institution should be readily ascertainable.

The authors of the report have expressed no opinion on the policy of assisting the various objects for which grants are made, but they are of opinion that they may properly review the very complicated machinery by which that policy is being carried into effect. Various political and Empire questions, including the adoption of a general tariff and the approaching Ottawa Conference, which need not be entered into here, have come to the front to make the moment opportune for this review. The tariff and Empire preferences, for example, alter the basis upon which the Empire Marketing Board was formed in 1926, and the working of the Colonial Development Fund can now be reviewed in the light of experience which has been gained.

The Committee directs attention to the three-fold organisation for medical, agricultural, and industrial research, under the Lord President of the Council, now taking shape in Great Britain, its suggestion that these bodies should gradually become the controlling departments in their respective spheres will be welcomed.

In the event of effect being given to the Committee's suggestions, the new Advisory Council for Agricultural Research could take over portions of the work of the Development Fund, whilst certain of the work of the Empire Marketing Board might be absorbed by the relevant trade intelligence service. The grants from the Colonial Development Fund should be restricted, as was originally intended, to works of a capital nature, and grants such as have been recently sanctioned for ordinary government administrative purposes should be discontinued.

As regards the inter-relation and co-ordination of grants by the different Empire administrations, the Committee's report should enable this important side of the problem to be discussed with an added insight at the Ottawa Conference to be held in July.



### The Mind Judicial

- (1) *The Life and Letters of Sir Edmund Gosse* By the Hon Evan Charteris Pp ix + 525 + 18 plates (London William Heinemann, Ltd, 1931) 25s net
- (2) *The Religion of Man being the Hibbert Lectures for 1930* By Rabindranath Tagore Pp 239 (London George Allen and Unwin, Ltd, 1931) 7s 6d net

"Let it be granted —That a controversy may be raised about any question and at any distance from that question"—LEWIS CARROLL

"The human mind has compressed ages into a few years for the acquisition of steel-made claws . . . The new organs that to-day are being added as a supplement to Man's vital stock are too quick and too numerous for his inner nature to develop its own simultaneous concordance with them and thus we see everywhere innumerable schoolboys in human society playing pranks with their own and other people's lives and welfare, by means of newly acquired pen-knives which have not had time to become humanized"—RABINDRANATH TAGORE

WE of the body scientific are seeking to impose ourselves mentally upon the world—to rival the word painters—having long done so in ways mechanical and succeeded with terrible effect in part yet with much benefit in some fields. The money-changers have recognised our value by supplying us with capital but we have in no way learnt to curb the control they exercise upon society. To-day, apparently they hold us at ransom. We have the temerity to believe that the public health cannot be sound unless we intervene in its protection and even direct the lines of action. What then is our medical value, primarily, to society, our qualification to advise? To answer the question, we need to hold up the mirror very closely to ourselves—to ask what we see in ourselves that is special, what we ought to ask for, what we should find. To see more than darkly is very difficult—as years go by the field of view is ever widening, the need of grasping the whole field more obvious, the vision more and more clouded, less easy to interpret. We can but compare—nothing is absolute—through biography especially not necessarily through study of special books but constantly of thumb-nail sketches to be made here and there, indeed everywhere.

I have long advisedly watched the game we play and often asked myself what its meaning was, how it might be directed and brought under rule, so as to be of more avail than it is. No general answer is forthcoming. I entered upon my career as a

student thirsting for knowledge of method. My first books—"Pepper's Playbook of Science" in particular—had told me of much that was interesting but nothing of the process by which the knowledge had been gained. How could one learn to do such things? I found the teaching dogmatic—Huxley's especially—but much of it was practical and went home. Gradually, in Germany particularly, the method in the background began to leak through, so that I was able to build outlines of a system.

When I began to teach, in 1870, I already had a conscious purpose and desire—to aid in introducing what Charles Kingsley had so aptly termed the method of sound scientific thought. We were then at the Darwin-Colenso stage—faith was giving way to fact. We began by fighting down the cramping system of payment by results administered by Matthew Arnold and others, more freedom of thought seemed to prevail but only during a brief interval. In stealthy ways, first through the inspector, the examiners have not only recovered their position but also have raised their dread power to that of inquisitioners. We are fallen back into the paths of primitive religion. unquestioning faith, not eternal doubt, is the demand now made upon the student. There's not to reason why, there's but to do and die. Were it not for a few pathfinders, our so-called science would be entirely romanised in its methods—this is why it is proving to be of so little public worth in lifting the masses into intelligence. The sale of moral filth is being consistently cheapened. No considered effort is being made, from our side, to meet what desire there may be for healthy knowledge. A transcendent future and the inwards of atoms are held out for popular consumption, the present doings of the hordes of earthly molecules remain unnoticed. We make no attempt to get down to any understanding of life as it is. The talk is all of the past—which we study but do not heed. Whence springs the new discipline of science? What is there in ourselves from which it is bred? It is in some way a natural product but of rare occurrence. Is this accident or inevitable?

The point of view from which I would consider the biography of Sir Edmund Gosse will be apparent from these remarks. He died in May 1928. A critic and literary publicist of some distinction, much given to the study of current French literature, librarian to the House of Lords, 1904–14, he was best known in his last years on account of the felicitous weekly literary article which he contributed to the *Sunday Times*, after he left the

Lords The one work which won him distinction was his "Father and Son" (1907)—an intimate account of his most remarkable father and mother and of his own early upbringing under their affectionate but severe guidance. As a biography the book now ranks as a classic, of great historical and psychological value. I read it with intense interest when it was first published. Although issued anonymously, it was easy to guess who father and son were—"Goose and Gosling", you mean", at once said the late Israel Zangwill, when asked if he had read the book.

The father—Philip Henry Gosse (1810–87)—was a zoologist of repute, a fellow of the Royal Society, to which he contributed no less than sixty-two descriptive papers. Brought up in a severely puritan atmosphere, he early developed great natural aptitude as botanist and zoologist, at the same time he became intensely religious and eventually a member of the Plymouth Brotherhood, a sect closely akin to the Sandemanians, to which Faraday belonged. He wrote a number of popular natural history books, which he himself illustrated. His father, although a painter, was an indefatigable writer. Philip Gosse married Emily Bowles, who was of New England descent, she was a successful writer of tracts. In her son's opinion, she had in her the making of a novelist but advisedly abstained from writing, being naturally of a very devout and pious turn of mind. She had formed a definite conception of the absolute, unmodified and historical veracity, in its direct and obvious sense, of every statement contained within the covers of the Bible.

Edmund Gosse, therefore, had a strong infusion of literary blood in him, hence we can understand how it was that he became a victim of what his grandmother called—that cursed writin'.

The turning point in Philip Gosse's career came when Darwin's "Origin of Species" divided the ranks of naturalists. Gosse appears to have been privately advised of the theory in advance by Hooker, Darwin and Lyell, with the view of joining in its support. As a naturalist he was at first inclined to favour it but soon reverted to the first chapter of Genesis—he forthwith wrote, as a challenge, in advance, his celebrated "*Omphalos*" (1857)—an attempt to untie the geological knot.<sup>1</sup> He argued, quite logically, that an all-important factor had been left out of account—'the Law of Prochronism in creation'. He contended that when the catastrophic act took place, the world presented instantaneously the appearance of a planet on which life had long existed, fossils in-

cluded—made to order with all other things. Such was faith—such the power of the Bible in days before Darwin.

We may think him narrow but taking the state of opinion into account, Gosse's mental attitude, I venture to think, was in no whit different from that prevailing to-day among students in nearly all branches of science. 'And Arrhenius said—Let there be ions and there were ions', is as firmly believed in by the majority as any fiat in the first chapter of Genesis was by Gosse. Our general mental reactions are the same as they were—we still worship authority, only some have changed their book and have new gods. The point is—Gosse had a closed mind so have most of us. Darwin still has few supporters, prepared not merely to face the facts but demanding suspension of judgment until the case be complete.

The young Huxley scoffed at Gosse's book and Charles Kingsley gave him no support. He became a mental wreck through disappointment and was no more seen at the Royal Society. To the last, he remained in expectation of the personal coming of the Lord. His son's biographer writes—"his faith, being cast in bronze and unassailable, did not suffer but his dogmatism grew less vociferous, a new gentleness tempered his outlook towards the opinions of others and blent with his affection for his son."

How is such a man to be classed? Not among scientific thinkers. He was contemporary with Carlyle, Charles Kingsley and Ruskin. These men were all literary and greatly devoted to the Bible, all greatly influenced by its teachings but without Gosse's bigotry. Ruskin was the most fully imbued with its spirit and saturated with its language, he was also a naturalist, a geologist of no mean order, as an art worker he was exceptionally exact and scientific, yet a rhapsodist and unscientific in general outlook. Carlyle was the rigid scholar in outlook but dour in spirit and interests. Kingsley was the hearty, sporting country clergyman, supercharged with energy, a good pen and imbued with a clear conception of scientific method. At one time he was overcome by doubts, even Ruskin confessed, in late life, to the feeling that he might have been led to change his views had he dared to reconsider their validity.

Edmund Gosse was not only different from his father but seems also to have been little influenced mentally by his severe training at the hands of his parents. He did not even assimilate biblical English. He early became emancipated in a re-

markable way When about six years old, he lost his belief in his father's omniscience by discovering that his statements about things in general could not be implicitly accepted Then he began to question the efficacy of prayer, to which absolute value was attached by his parents, when told that he must not pray for things, although the view held by the household was that if anything were desired you should not lose any time in seeking for it but ask God to guide you to it

Finally, when idolatry was severely condemned at mission meetings, particularly bowing down before wood and stone, he decided to make an experiment hoisting a small chair on to the table close to the window, he said his daily prayer in a loud voice, substituting the address "O Chair" for the usual one He expected that God would certainly exhibit his anger and chastise his impious and wilful action Nothing happened His conclusion was that his father was not really acquainted with the divine practice in cases of idolatry What might have happened had such a thinking child been taught properly to experiment and reason? I commend the problem to the attention of Dr Lyttelton

His father trained Edmund Gosse so thoroughly as an observer and collector of marine organisms that, before he was five years old, the boy discovered 'a tiny atom', which he carried to his father as a form 'with which he was unacquainted', since figured on lists of sea-anemones as *Phellia macrocinela* or the walled corklet The training, however, had no effect in leading him to take up such study One lesson he had from his father, in about his fourth year, is worthy of notice, we may even say, 'Teachers, please copy'

"In particular, he had a scheme for rationalising geography, which I think was admirable I was to climb upon a chair, while, standing at my side, with a pencil and a sheet of paper, he was to draw a chart of the markings on the carpet Then, when I understood the system, another chart on a smaller scale of the furniture in the room, then of a floor of the house, then of the back-garden, then of a section of the street The result of this was that geography came to me of itself, as a perfectly natural miniature arrangement of objects and, to this day, has always been the science which gives me least difficulty"

Edmund Gosse became emancipated when he came to London at the age of seventeen Through the influence of Charles Kingsley, he found an opening at the British Museum in the cataloguing section. Thereafter he reverted to his type and became a mere man of words, showing no particu-

lar interests outside humanistic literature. The "Life and Letters" contains many of his letters but there is little in these of interest or in any special way informative that a father and mother of ultra-rigid outlook should give rise to a son, if not of loose opinions, of no opinion in particular about any subject yet with some gift of words, is very remarkable The story is of value in connexion with the present attempt to produce biologists—can men worth their salt be nursed into being by any education? I doubt it

Man to the chemist is a composite structure of organic compounds—life the interaction of molecular forces Outside this definition we cannot go—nor do we see how those who cannot think in terms of chemistry have the right to go further either in assertion or denial In the laboratory the possibilities are infinite, in ourselves they are limited—we are built, it seems, to pattern, of selected oriented materials, our operations are as strictly controlled as if we ran upon roads and rails Nature, the dear old nurse, has so taken us by the hand that she regulates our actions by drugs—nerves seem to be only of secondary value, conductors of impulses and orders We are bedrugged not only from within but also from without—by an astounding set of 'factors' which are gradually being dragged into the open, as definite crystalline substances The outlook grows more and more 'mechanised' every day

"That which merely gives us information can be explained in terms of measurement but that which gives us joy cannot be explained by the facts of a mere grouping of atoms and molecules", says the poet Rabindranath Tagore What of the "joy" that is to be obtained by merely pricking a little morphine into the blood stream? I would range all the controlling agents under the name advitants—endogenous or exogenous They are all carbon compounds, some of simple, some of complex structure Whatever their mode of action, it certainly is the outcome of peculiarities in their structure From this point of view, the various types of mentality are due to variations in the structure of our own composite mechanism

One type is necessarily dominant—the literary So soon as man rose in numbers, words gained control and the wordy perpetuated their kind, the while doing the minimum of manual work To write is but to talk upon paper To maintain society subservience became necessary The able came together but kept themselves under, through jealousy. the adventurous naturally often fell victims. Only the few could be allowed to think

To-day we are advisedly limiting their number by declining to breed them. Hence the present state of society—and it may become far worse.

The industrial element has been gradually developed through the rise of intelligent men from the working masses. This class alone has encouraged invention and experimental inquiry. The literary class has parasitically enjoyed the fruits of the work of the industrial class, without ever entering into its methods. At all times, the commercial instinct must have been more or less developed in all men, as man is necessarily individual. No communistic experiment such as the Russians are seeking to make has hitherto been successful. It is easy to see how a merchant class is arisen and, with its power of the purse, has assumed control in modern industry without sufficiently understanding what it controls.

It is clear that, in the future, divided control—involving the inclusion of all necessary elements—can alone give what is needed. The German industrialists have already proved this to demonstration. They have also already found that it is easy to go too far. Recent events also show how, in matters of government, it is being recognised that expert aid is essential to success. We are on the way to recognise that the introduction of scientific method into our affairs cannot much longer be avoided. The attitude of ultra-conservatives like Lord Snowden and Sir Herbert Samuel is of extraordinary interest, showing their complete inability to interpret the changes introduced into the world at the hands of workers in natural science, as distinct from humanistic science. The Realists must have it in the end. It is no longer a question what the masses do: the problem is what the few can and must do to provide occupation, food and lodging for the masses.

"To-day more than ever before in our history, the aid of spiritual power is needed. Its sources will surely be discovered in the hidden depths of our being. Pioneers will come to take up this adventure and suffer and through suffering open out a path to that higher elevation of life in which lies our safety."

"The vastness of the race problem with which we are faced to-day will either compel us to train ourselves to moral fitness in the place of merely external efficiency or the complication arising out of it will fetter all our movements and drive us to our death."

The poet has vision where the scientific worker is unseeing. He preaches a true religion of man—something above research as this is now understood.

HENRY E. ARMSTRONG

### Teaching of Mathematics

- (1) *The Teaching of Arithmetic in Schools: a Report prepared for the Mathematical Association*. Pp 82. (London: G. Bell and Sons, Ltd., 1932.) 2s net.
- (2) *The Teaching of Elementary Algebra*. By Clement V. Durell. Pp viii + 136. (London: G. Bell and Sons, Ltd., 1931.) 3s 6d net.

NOT only is the science of mathematics constantly pushing forward its boundaries, but the old territory is also being examined afresh, and new methods of approach are being suggested and tried. Of this latter fact the two little books under review afford clear evidence.

(1) The first, which deals with the teaching of fundamentals, is issued by the Mathematical Association, and it is difficult to overrate the influence exerted by this Association on the teaching in secondary schools. It has already introduced reforms, notably in subtraction and multiplication, which, though they may seem trifling when viewed by themselves, profoundly affect the work in the more advanced stages. This new Report suggests no startling innovations, but it stands as a compendium of the most enlightened methods practised in our schools to-day. It advocates uniformity of method, so far as that is practicable, within the same school, but it gives a number of different methods without dogmatising about their relative values. It is quite definite however, in its recommendations, and it shows commendable courage in modifying its previous recommendations where they have not stood the test of practical experience in the classroom.

(2) Mr Durell's book, representing as it does the opinions of one man, belongs to a different category. Its teachings are more open to controversy. It expounds with great lucidity the views of the modern school, views which the present reviewer regards as essentially sound. In the days of his youth, Todhunter and Colenso wrote the authoritative textbooks in algebra. They set a fashion, or rather perpetuated a fashion, which is largely followed up to the present day. The defects of the tradition are many. One is that it introduces algebra as a new subject, and not as a natural development of the science of number which the pupils have previously been studying. Another is that it attaches undue importance to the manipulation of symbols as distinct from an understanding of their significance. A third is that it ignores the fundamental distinction between directed and non-directed numbers, a distinction which was first brought out prominently in England in Sir Percy

Nunn's epoch-making book. The intelligent student of the olden days used to feel vaguely that the signs + and - were used ambiguously, that they were sometimes used as verbs and meant *add* or *subtract*, and sometimes as adjectives, and defined the number that followed as *positive* or *negative*. But the distinction was never brought out clearly in the text-books.

The new school of algebra teachers, of whom Mr Durell is a good representative, has changed all that. It has made the clear comprehension of what directed numbers mean one of the essential aims in the teaching of algebra, and it has so devised the approach to the study of algebra that the gulf between it and arithmetic should disappear. There is a difference of opinion whether that approach should be via the equation, or via the formulæ that are used in mensuration and in science. Mr Durell favours the latter, and gives very cogent arguments for his preference. He writes well, seasons his theories with an abundance of common sense, and presents the reader with valuable hints on teaching which are based on a wide personal experience. P. B. BALLARD

### Systematic Zoology

*Klassen und Ordnungen des Tierreichs, wissenschaftlich dargestellt in Wort und Bild.* Von Dr. H. G. Bronn. (1) Band 3, Abteilung 3 *Bivalvia* (*Muscheln*). Bearbeitet von Dr. F. Haas. Lief. 1. Pp. 176. 1950 gold marks. Lief. 2. *Schriftenverzeichnis*. Pp. 292. 38 gold marks. Lief. 3. Pp. 177-384. 28.80 gold marks. (2) Band 4 *Vermes*. Abteilung 2 *Aschelminthen*. Buch 1. *Rotatorien, Gastrotrichen und Kino-rhynchen*. Bearbeitet von A. Remane. Lief. 1. *Rotatorien*. Pp. 160. 20 gold marks. (Leipzig. Akademische Verlagsgesellschaft m. b. H., 1929-1931.)

(1) **O**F the three parts of this new account of the bivalve molluscs, one (the second section) is entirely occupied by an alphabetical list of almost 7000 titles of books and papers on the class published up to the end of 1928. The author promises a further list of more recent works when the text is finally completed. This account of the bivalves is planned on a liberal scale, for the two parts of the text before us, altogether 384 pages, carry the description only so far as the shell and the cognate subject of pearls. The characters and classification of the *Bivalvia* are briefly set forth; three main orders are recognised—Ansomylaria, Taxodontia, and Eulamellibranchiata, the last

divided into five sub-orders. A short account of the form, relations, and positions of the organs prefaces the detailed consideration of the shell, which begins with the description of the varied external features and the mathematics of the curvature of the shell-valves.

The author has given very adequate attention to the sculpture and colouring of the shell surface, the structure and chemical composition of the component layers of the shell, the interlocking mechanisms and the ligament, and the sexual dimorphism exhibited by the shells of a number of species which have been described under different names for the two sexes. The last eighty pages, devoted to a description of the different kinds of pearls and their modes of formation, form a useful summary of present knowledge of this subject. The text is illustrated by 200 clearly drawn figures. We look forward to an equally adequate account of the soft parts.

(2) The Rotifers are usually regarded as 'a small group', but the number of species known is stated to be more than 900, and the number of species living is probably not less than 1500. The literature is extensive—the author states that a list of the published papers will occupy almost 100 pages—and is widely scattered, and therefore a new account of the group by an author so competent will be welcomed by professional and by amateur workers. Both of these will regret some of the changes in nomenclature, for example, *Epiphanes* instead of *Hydatina*, *Floscularia* for *Melicerta*, which appear to be necessary if the double nomenclature employed for certain genera since 1913 is to be avoided. A statement of the characters of the Rotifera is accompanied by six useful original drawings showing the anatomical features as seen from dorsal, ventral, and lateral aspects. This is followed by an excellent account of the history of our knowledge of the Rotifera which, apart from a note by John Harris (1696), begins with Leeuwenhoek's descriptions of some of these animals, among which the well-known *Melicerta ringens* (or, as it is to be called, *Floscularia ringens*) is clearly recognisable.

The historical section is divided into four periods—the first from 1696, the second from 1838, when Ehrenberg's well-known work on Infusoria appeared, the third from the time of publication of Hudson and Gosse's monograph in 1886, and the fourth from Beauchamp's memoir in 1909. In a brief statement on the size of Rotifers, the author remarks that the smallest, *Ascomorpha minima*, which is about 0.04 mm long and 0.03 mm broad,

is the smallest known metazoan. The different forms of the body of Rotifers, the jointing of the body, the head and its corona and processes, the appendages of the trunk, and the foot are considered. The ciliation of the trochal region is traced from the primitive type, most closely approximated in *Notommata*, through the varying forms represented by *Pedalia*, *Floscularia* (*Melicerata*), *Philodina*, *Epiphanes* (*Hydatina*), and *Brachionus*, and a description is added of the wheel-organs of each family.

A clear account is given of the glands, including the retrocerebral organ, the different grades of development of the lorica, and the three kinds of envelope—the gelatinous, as in certain *Flosculariacea*, the secreted case of firmer consistency, as in the Bdelloid genus *Habrotrocha*, and the envelope formed of foreign particles, as in *Floscularia ringens*. The illustrations, 153 in number, are well chosen and clearly reproduced.

### Short Reviews

*Das Tierreich eine Zusammenstellung und Kennzeichnung der rezenten Tierformen*. Gegründet von der Deutschen Zoologischen Gesellschaft. Im Auftrage der Preussischen Akademie der Wissenschaften zu Berlin. Herausgegeben von F. E. Schulze and W. Kukenthal.

- (1) Lief. 54 *Myriapoda 2 Scolopendromorpha*. Bearbeitet von Dr. Graf Attems. Pp. xix + 308. 50 gold marks.
- (2) Lief. 55 *Amphibia Anura III., Polypedatidae*. Bearbeitet von Dr. E. Ahl. Pp. xvi + 477. 77 50 gold marks.
- (3) Lief. 56 *Acarina, Bdellidae, Nicolettiellidae, Cryptognathidae*. Bearbeitet von Dr. Sig. Thor. Pp. xiii + 87. n.p. (Berlin und Leipzig: Walter de Gruyter und Co., 1931.)

(1) DR. GRAF ATTEMS gives a brief account (16 pp.) of the external morphology of the Scolopendromorpha and defines the two families, Scolopendridae and Cryptopidae, which constitute the order. In the first of these families are 16 genera with 238 recognised species, besides a further 44 species of uncertain position; in the second family are 12 genera with 106 species, with a score which are incompletely described. The discrimination of genera and species is made as straightforward as possible by the provision of excellent keys and of clearly drawn illustrations, 387 in number.

(2) A brief description of the salient biological and structural features of these tree frogs precedes the systematic account of the twelve genera and 527 species—found in the African and Indo-Malayan region—which are included in the family Polypedatidae. Noteworthy are the keys devised for the separation of the large genera *Rhacophorus* and *Hyperolius*, each of which contains nearly two hundred species. The systematic characters are

set forth clearly, and for many of the species in considerable detail, and there are 320 figures, mostly in half-tone, representing usually the dorsal aspect of the frogs.

(3) The systematic treatment of the Bdellidae or snouted mites is prefaced by a useful account of their external features, internal anatomy, life history, and biology. For the less-known Nicolettiellidae a briefer description suffices, and for the very small Cryptognathidae, with only one genus and two species, the general account is restricted to the external features, as the development, internal anatomy, and the nature of the food of these mites are unknown. The keys, systematic descriptions, and illustrations have been carefully prepared by Dr. Sig. Thor, to afford the maximum of help in the difficult task of determining these mites.

Each volume has a systematic index and "nomenclator generum et subgenerum." The three parts before us worthily maintain the high traditions of the series to which they belong.

*Electrical Insulating Materials an Engineering Treatise on the Production, Characteristics and Uses of Electrical Insulating Materials*. By H. Warren. Pp. 516. (London: Ernest Benn, Ltd., 1931.) 42s. net.

THE insulating materials from which the designer has to choose cover a very wide range of natural and artificial substances. They vary from rocky deposits, like slate and marble, to highly complicated synthetic resins. The engineering expert has to familiarise himself with all of them, and choose for his special purposes those with suitable characteristics. Mica is the most important mineral material for insulating work. Its excellent electrical properties, great mechanical strength, ease of cleavage into continuous laminae, purity, chemical inertness, and resistance to high temperature put it into a class by itself. It is used in natural plates for condensers, certain heating devices, and small commutators. It is also used for non-electrical purposes, such as sound-producing diaphragms, and to build up composite materials.

On the other hand, materials like casein, the albuminoid which is the basis of cheese, is sometimes used for switch covers, lampholders, etc., especially abroad. The manufacturer has to consider ease of working and the degree of polish possible, as well as the electrical and mechanical properties of the materials. He will find this book most useful for reference, and parts of it suggestive and instructive.

*Manx Algae: an Algal Survey of the South End of the Isle of Man*. By Dr. Margery Knight and Mary W. Parke. (L.M.B.C. Memoirs on Typical British Marine Plants and Animals, 30.) Pp. vii + 155 + 19 plates. (Liverpool: University Press of Liverpool, London: Hodder and Stoughton, Ltd., 1931.) 10s. 6d.

BRITISH workers in the field of marine algology have been seriously hampered for many years by the paucity of literature. The present memoir is



a welcome addition, being the result of some years of work at the Isle of Man research station. It includes the Chlorophyceæ, Phæophyceæ, and Rhodophyceæ, and embodies the results of a systematic survey of the south-east corner of the island.

The first part of the book gives an account of the way in which the marine algæ perennate, and separates them into perennials, pseudo-perennials, and annuals, basing the categories on the extent of thallus destruction in the autumn and the extent of the growing period. An interesting account is also given of the algal migrations in the littoral zone, careful observation having revealed the fact that the algæ move up and down the shore with a seasonal periodicity that can possibly be correlated with changes in external factors, such as light and temperature. In all cases the onset of unfavourable conditions appears to be heralded by copious reproduction. So little work of this kind has been published that this section of the book will be especially welcomed by algologists.

In addition to this, the authors have compiled a list of algæ for the area concerned, with their precise localities and time of reproduction. They have also constructed a key for the identification of these same genera.

The plates and maps are a useful asset, those of the former, showing the algæ *in situ*, being a particularly pleasing addition to the volume.

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*Vergleichende Stammesgeschichte Grundlagen, Methoden, Probleme unter besonderer Berücksichtigung der höheren Krebse*. Von K. Beurlen (Fortschritte der Geologie und Paläontologie, herausgegeben von Prof. Dr. W. Soergel, Band 8, Heft 26). Pp. viii + 317-586. (Berlin: Gebrüder Borntraeger, 1930.) 30 gold marks.

PALÆONTOLOGY, compared with zoology and botany, suffers many disabilities, but these are in part outweighed by one advantage which the sciences concerned with living organisms cannot possess—the time factor. This advantage is particularly evident in studies dealing with the broader aspects of phylogeny. In this present work is given a detailed examination of the phylogeny of the higher Crustacea. Two main periods of development are suggested, outside which no new types have arisen. At these times development was explosive, many new types arising between which no transitional forms are found. The course of development in the many other animal groups briefly analysed by the author appears to be parallel to that given for the Decapoda: each developmental cycle is characterised by two stages, the first in which new types suddenly appear, and the second in which these types undergo continuous modification.

The work concludes with a discussion of many problems and theories of evolution, such as orthogenesis, adaptation, and function and form—"Die Funktion folgt aus der Form." Although the subject matter of the book is thus mainly bio-

logical, yet it appears likely that many of the suggestions contained in it must eventually be approached from the geological side.

*Tara: a Pagan Sanctuary of Ancient Ireland*. By Prof. R. A. S. Macalister. Pp. vi + 208 + 10 plates. (London: Charles Scribner's Sons, 1931.) 10s. 6d. net.

PROF. MACALISTER'S "Tara" is a study in archaeology and traditional history combined such as would be possible nowhere but in Ireland. He takes his readers over the ground of this famous centre of Ireland's history with the "Dindsenchas" in his hand. Point by point the account of Tara given in this 'guide-book' of the ninth century is compared with the site, and it is shown how far the structures mentioned may be identified, or with what degree of certainty the position of others may be conjectured. Prof. Macalister's plea for a scientific investigation of the site is justified repeatedly. It is a work which might well be regarded as a national duty.

Prof. Macalister is on less solid ground when he turns to the unravelling of the traditions connected with Tara. He puts forward the extremely interesting suggestion that it was the centre of a 'Twin' cult, and the sanctuary of a priest-king like the Grove of Nemi, the Irish king being exposed to the same fate of slaughter by a stronger rival as the Italian ministrant of the sacred grove. Prof. Macalister's theories offer material of much interest for discussion, but without much hope of arriving at any certain conclusion on the evidence as it stands at present.

*The Psychology of Children's Drawings from the First Stroke to the Coloured Drawing*. By Helga Eng. Translated by H. Stafford Hatfield. (International Library of Psychology, Philosophy and Scientific Method.) Pp. viii + 223 + 8 plates. (London: Kegan Paul and Co., Ltd., 1931.) 12s. 6d. net.

THE subject of this book is a very fascinating one and deals with the development of children's drawings from the first ill-defined scribbling of the infant through the formalised drawings of older children. The author points out that small children draw not so much what they see as what they know. In the final chapter, there is provided a comparison of children's drawing and the art of primitive man. It is emphasised that so many of the drawings found on cave walls, etc., and attributed to primitive man, are works of art, and could not be produced by any present-day child or adult of average ability. They are the work of the artists of the day. The drawings of children always show a formalism, stiffness, and want of expression seldom seen in the work of primitive man. There is in the work of the ancient artists a representation of expression, of movement, of reality which is not seen in the drawings of children. There is still room for a vast amount of work to be done on the development of children's drawings, their relation to eidetic imagery, to mental development, and the phantasy life of the child.

### The Uncertainty Principle in Modern Physics

SOMEWHERE in the literature of the theory of relativity occurs the statement "The theory of relativity is physics, and we render it no good service by too hastily attributing to it a philosophical or indeed a speculative metaphysical meaning." Prof C G Darwin, in his Friday evening discourse before the Royal Institution on Feb 26, did not quite make the same statement about the uncertainty principle, but he stressed its physical side and had only a word or two to say on its other aspects. Prof Darwin believes that the question of human free will is not touched by recent developments in physics. It is doubtful if any of the old deterministic descriptions of Nature were antagonistic to the doctrine of human free will, for it is a presumption to suppose that the organic world is controlled only by the laws of physics and chemistry. Since the Heisenberg uncertainty relations are also laws of the inorganic world, it is again a presumption to suppose that they control those activities in which human beings feel that they have freedom of choice. What the new principle does is point out to the 'die-hard' determinist that there is nothing in physics which makes the idea of free will absurd.

Prof Darwin's lecture was a very clear exposition of the principle, and those who were not present to hear it will profit by reading the printed version. He gives an excellent illustration of the completely wave-like character of particles. If electrons are shot through two small holes situated close together in a screen, they produce an interference pattern on a photographic plate placed to receive them on the other side. If one hole is covered so that a pin-hole camera results, the electrons passing through the remaining hole produce general fogging of the plate. This is an experiment which can be performed in thought only, it is given as a type and contains the essential point of other practical experiments. It brings out the fact that these showers of particles have more than a particle aspect, they are also waves.

The Heisenberg uncertainty principle is the expression of our inability to locate a particle, for example, an electron, and to measure its momentum accurately at the same time. Heisenberg appears to take the view that processes in Nature are discontinuous. Other exponents of the theory assume that the laws of Nature are average or probability laws. They go so far as to say that the principle of causality no longer holds in the old sense in which that principle was applied.

Another possible conclusion is that the new principle is a consequence of our predilection for the description of phenomena in space-time, and that a wider background than that provided by the four variables  $x$ ,  $y$ ,  $z$ , and  $t$  would make the principle unnecessary. This question and the attempt to discover a unitary method of description in physics are closely associated.

The theory of relativity stresses the lack of union between gravitational and electromagnetic pheno-

mena, and since its advent several attempts have been made to unite these two domains. Weyl, Eddington, and Einstein have all succeeded in doing so, but quantum phenomena stand aside from their theories in the same way that electro-magnetism stood aside from Einstein's theory of gravitation.

Dirac's equations, especially in Darwin's form point to a remarkable analogy between the quantum and electromagnetic theories, and it has been shown that these fundamental equations of the new quantum theory are expressible in the form of a vanishing divergence, when the geometrical background is that afforded by the use of five variables. This at once suggests the possibility of union of all the three domains, and the theory has been successfully developed.

We are here concerned with one result arising from this unitary theory, namely, the fundamental importance of the length  $h/m_0c$ , associated with any particle of mass  $m_0$ .

The theory shows that Planck's assumption of the existence of a quantum of action and the Wilson Sommerfeld relations both lead to the result that no length less than  $h/m_0c$  is detectable in association with the particle.

The principle, stated in a slightly different form has been called the principle of 'minimum proper time'. The length in this case is measured along the track of the particle in space-time. When interpreted in terms of ordinary space and time, it means that in the case of a particle moving with velocity  $v$ , the smallest detectable length is

$$\Delta l = \frac{h}{m_0c} \frac{\beta}{\sqrt{1-\beta^2}} \text{ where } \beta = v/c,$$

and the smallest detectable interval of time is

$$\Delta t = \frac{h}{m_0c} \cdot \frac{1}{\sqrt{1-\beta^2}}.$$

This means that there is always an uncertainty in the position of the particle of amount  $\Delta l$ . The amount increases with the velocity, and if the velocity of light could be attained, it would be impossible to locate it at all. Like a monochromatic wave, it might be said to occupy all space. This principle of uncertainty was also discovered by Ruark in 1928 in a different form and by a different method, but his statement of it is evidently the expression of the same principle. Since that time it has been frequently rediscovered and discussed.

In spite of the fundamental difference between this principle and that of Heisenberg, it can be shown that it leads to his relations when the distances concerned are small. A very interesting result follows from an application to atomic orbits. No atomic orbit can be shorter than  $\Delta l$ , otherwise we could detect its existence through the spectrum of the atom in which it occurs. It follows from this that there is a maximum atomic number, and calculation shows the number to be 97. The prir

ciple admits the possible existence of heavier nuclei, but declares that it is impossible for atoms of higher number, built on the Rutherford model, to exist with their full complement of electrons. If the laws we discover in physics hold in all parts of the universe, we deduce that there is this definite limit to the number of elements existing. This is an interesting conclusion, and it is remarkable that the number falls so close to the number of elements at present known, namely, 92. The principle behaves here as a condition of stability, and it may be that elements of higher number than 92 are extremely unstable, and now remain only in minute quantities.

This question of the maximum number of elements possible has been discussed by V. V. Narlikar in *NATURE* for March 12, p. 402, 1932. The notation and method of Sir Arthur Eddington have been applied, and from considerations of invariance the maximum number obtained is 92.

The unitary theory and uncertainty principle deduced from it indicate that observers in space and time will discover both space and time are discontinuous, for their measurements of intervals of length and time will always be in integral multiples of  $\Delta l$  and  $\Delta t$ . The method of arriving at this conclusion indicates that this discontinuity underlies the old quantum theory.

H. T. FLINT

### Sir Charles Parsons and his Work

"SAVERY, Newcomen, Smeaton, the famous Watt, Woolf, Trevithick, and some other English engineers were the veritable creators of the steam engine," said Sadi Carnot in his essay of 1824, while a year ago the *Engineer*, on the occasion of the death of Sir Charles Parsons, remarked that "to Great Britain belongs the credit for the origination of nearly all the fundamental inventions for the production and industrial utilisation of heat energy."

Although during the nineteenth century many improvements in heat engines, more especially in internal combustion engines, were made abroad, it remains true that it is in the records of the British Patent Office that most of the outstanding inventions made in connexion with steam engines and steam turbines are to be found. With the steam turbine will ever be associated the name of Sir Charles Parsons, who, as Sir Alfred Ewing said when lecturing on the work of Parsons at the Royal Institution last November, "was incomparably the most illustrious and most revolutionary engineer of his time." In view of the long and close friendship of Sir Alfred with Parsons, it was almost inevitable that on the occasion of this lecture, an account of which has recently been published, he should pay a tribute to him not only as an engineer but also as a friend. He therefore addressed his remarks not so much to those familiar with the steam turbine and its development, as to those who wished to know more of what Parsons did and how he did it, and what manner of man he was that he should be ranked so confidently among famous men.

Allowing for differences in time and circumstances, there is a remarkable similarity between the work done by Watt and by Parsons, and what the latter said of his great forerunner might well be applied to himself. When delivering the second Joule memorial lecture to the Manchester Literary and Philosophical Society in 1922, Parsons said: "James Watt's conclusions appear to have been the result of close and patient reasoning of a mind endowed with extraordinary powers of insight into physical questions, and of drawing sound practical conclusions from numerous experiments devised to throw light on the subject under consideration."

In his early surroundings, Parsons was even more

fortunate than Watt, and his boyhood was spent in an atmosphere calculated to stimulate to the highest degree his interest in science and the mechanical arts. His father, by his construction of the famous reflecting telescope, had made Birr Castle the 'Mecca' of astronomers all over the world, while his mother possessed manipulative skill of no mean order. His tutors, too, were men of the highest calibre. In its influence on its various members, the home at Birr may well be compared to that of the Darwins at Downe. From it, Parsons emerged one of the most industrious of men, but also one of the shyest, and the effects of his unconventional boyhood remained stamped on him for life. It was his natural reserve and modesty—characteristics possessed by few inventors—which puzzled strangers. "His hesitating, fragmentary speech, his passive hand-shake, his somewhat shrinking manner," said Sir Alfred, "gave at first an impression of ineffectiveness which completely belied the latent force, the precision of purpose, the resolution that treated obstacles only as incentives to further effort, the fertility of invention that never accepted defeat."

Of Parsons' invention and development of the steam turbine, it may be said it was a piece of creative work comparable to that of a great writer or artist. Moreover, it was one for which the time was ripe, and which immediately and successfully fulfilled its purpose. The slow-speed reciprocating engines developed from the original inventions of Newcomen and Watt were ill adapted for driving the electric generators which were just coming into use when Parsons started work, and he was but one of many who attacked the problem of high speed. De Laval solved it one way and Parsons another. Thanks to the authorities at the Science Museum, Sir Alfred was able to exhibit at his lecture the historic turbo-generator Parsons made in 1884 and exhibited in the Inventions Exhibition of 1885. Running at the extraordinary speed of 18,000 revolutions a minute, the turbine drove an armature of only 2½ in. diameter, the construction of which displayed as much ingenuity as the turbine itself. It was not mentioned by Sir Alfred, and it is little known, that among the important novelties in this machine was a system of forced lubrication.

At first the Parsons turbine was used without a condenser and was "a notorious steam eater". How Parsons brought in the compound turbine, the condensing turbine, the marine turbine, and the geared turbine, and how he successfully attacked the many problems which arose as the turbine gradually superseded steam engines in power-houses and ships, Sir Alfred made clear with the help of lantern slides, but unfortunately the report of his lecture has no illustrations.

It was once said that the work of Parsons had halved the cost of generating electricity. That is probably well within the mark. The relative importance of turbine plant to-day is shown by the official statistics quoted by Sir Alfred. "British power-stations in 1930", he said, "show that steam

turbines provided more than  $5\frac{1}{2}$  million kilowatts, while all the other types of heat engines accounted for less than a quarter of a million." But neither the generation of power nor the propulsion of ships monopolised the activities of Parsons. He spent much time and money in the attempt to produce artificial diamonds, worked out a scheme for boring a shaft in the earth's crust 12 miles deep, studied the casting of large steel ingots, and in his later years turned to the subjects which had engrossed his father and became a maker of optical glass and a constructor of large telescopes. No one to-day doubts that he was the most illustrious engineer of his time, and a biography of him should prove of the greatest value to students of both science and engineering.

### The Great Barrier and the Formation of Coral Reefs

DR YONGE divided the plan of operations of the Great Barrier Reef Expedition into four sections: (1) the detailed study of the feeding of corals, (2) the plankton and sea-water, (3) an ecological study of corals and associated organisms, and (4) the examination of the bottom flora and fauna, with the determination of the zoning of life at increasing depths (NATURE, 121, 213, 1928). The British Museum (Natural History) has now commenced to publish the results in these four sections. Dr Yonge's own work is mainly included in vol. 1 and has been already sufficiently summarised in NATURE, 127, 309, 1931. It is a very remarkable study of the feeding of corals, from which he concludes that symbiotic algae are "an indispensable factor in the necessarily exceptional powers of growth and repair possessed by the marine communities known as coral reefs." This is as much as concerns the student of the formation of coral reefs.

The methods for the collecting of zooplankton, designed mainly by F. S. Russell, require careful study, but comment is deferred until some quantitative and qualitative results are published. There were 189 hauls of the nets at 68 stations, together with a series of reef-flat plankton collections. For comparative purposes it would be useful if future marine expeditions adopted similar methods. The number of new species of animals obtained in the plankton may be small, the geographical region being the tropics, but the wealth of the collections is indicated in Mr. Barnard's "Amphipoda", more than a thousand specimens (23 species) of *Hyperidea* having been submitted to him for examination.

Vol. 3 contains papers relating to the structure and ecology of reefs. J. A. Steers's geographical introduction is intended for biologists who deal "with definite facts" while geographers "deal with theory." He might have added that biologists on this expedition set out to obtain and test their facts largely by experiment, thus differentiating this from all previous expeditions. Mr. Steers's main work is published in the *Geographical Journal*,

wherein he considers the formation of the Great Barrier Reef. He accepts the view that there was a post-glacial rise of sea-level, the coast platform having been formed largely by low-level Pleistocene abrasion, this following on down-faulting of a peneplain, composed of Pre-Tertiary rocks.

Dr. Stephenson contributes a happy report containing the outlines of the "Development and the Formation of Colonies in *Pocillopora* and *Porites*". He also, assisted by some members of his party, writes a long account of Low Isles and other lagoon reefs, and of one piece of the Barrier Reef. According to Miss Marshall and Dr. Orr's borings, Low Isles reef is a mere veneer of corals and other organisms covering a mud bank (NATURE, 129, 141, 1932). It has a very different foundation from any coral reef visualised by Darwin or any other student of the formation of coral reefs. Dr. Stephenson states that the organisms are extending the surface of the reef outwards, presumably debris being laid down in the waters around in such a way that this outgrowth is assisted. The reef itself was formed as one or more reef patches of a type described as "made of dead boulders and masses of coral with sand between and the surface very irregular and full of complex holes and crevices." The slope to the barrier lagoon is "covered by fixed blocks of dead coral of varying shape" and is illustrated by useful sections. "As the depths of the water increases they tend to become higher, and many of them form very large mounds", the tops often exposed at low water. Their sides are 20 ft. or more deep, and corals grow "on top of them and a little below the top." Nearer the shore they give place to a rugged area "covered by fixed blocks of dead coral." These perpendicular mounds seem to resemble those in the "zone of coral heads" on the lagoon side of Yonge Reef in the barrier series and formerly described in similar places by Surgeon Paradise, who is not referred to. Where I have seen similar structures they were in decay or stationary, and I await further evidence that they have been built

up by corals and are being added to the reef, in particular, I would learn of the destructive as well as of the constructive organisms and processes in and around Low Isles reef

Dr Stephenson should give his reference where he objects to the words "a typical coral reef" as "improper". Surely it is as improper to apply the names he has invented for parts of Low Isles Reef to Yonge Reef of the outer barrier, which appears to have been largely mortared and built by calcareous algæ not present in the former. Yonge Reef has no land and, except boulders, no part projecting above ordinary low tide level, whereas these inner reefs of the lagoon have an elaborate arrangement of cays, ramparts, and rocks above the level at which the building corals can live. Does our author reject the idea that there has been a lowering of sea-level in these regions in very recent times? There is "a general consensus of opinion amongst those who know" as to this (Steers), but in the summary of this report it is not even referred to. Were the superficial structures of Low Isles examined with this recent negative displacement of sea-level in view? If not, they require re-examination. In particular, the rocks shown in Plate V, Figs 3 and 4, might just as well be parts of a formerly continuous reef which is slowly washing away as boulders, if so, many of their building organisms should be in the position in which they grew.

Yonge Reef "was chosen for careful examination" so that a full account will doubtless follow. It is of infinitely greater importance to the student of coral reef questions than all these lagoon reefs. A reef against the open ocean in such a position has usually an outer narrow ridge a few yards behind the breakers broken by trenches, a reef flat at about low tide level, often in places a little lower, a boulder zone, and a lagoon flat. Yonge Reef is described as having the same outer ridge, inside which is a depression (outer moat) up to 5 ft deep and 100 yards broad. Then comes the "reef crest" a pavement of solid coral rock, swept clear of debris 160 yards in breadth", more or less exposed at low water, and this is succeeded by an ill-defined depression (inner moat) 50 yards broad, up to 18 in deep, rising into the boulder zone. The crest and inner moat seem to us to be comparable with the inner half of what is termed the reef-flat and to carry the same organisms, but the outer depression, up to 5 ft deep, is a most unusual feature that merits full description. We presume that it was found at Ribbon, Ruby, and Escape Reefs, justifying the statement that Yonge Reef is typical. It would help us to understand this reef had there been any mention of the genera of building algæ in the list of its fauna and flora and referred to as a "heavy incrustation of nullipores". In any event, Yonge Reef should never have been blended in this report with a series of lagoon reefs many miles away from the open ocean, for it will throw those who have not made personal examinations of coral reefs into inextricable confusion.

The systematic work of the bottom fauna is

published in vol 4, which at present contains nine reports. It commences with that of the Annelida by Mr. C C A. Monro, but was it worth his time to examine a collection of 46 species of Chaetopoda, of which more than half are represented only by single specimens? Clearly this class of animal, so important on shallow reefs, was never collected, and subsequent reports lead us to believe that only the obvious forms of life in such positions were collected. Enteropneusts suggest a similar story, only 2 species with 12 species of larvæ being described by E. Trewavas. Low island reefs should be almost ideal for the adults, and yet there are recorded only 21 specimens of *Ptychodera flava* and 8 "fragments" of *Balanoglossus carnosus*, which is described as "common on most sandy places". If only Mr. Monro, who has the specialist's knowledge, could be sent out to collect such groups of animals, on a tropical coral reef coast, what information we would have! He would settle his species on the spot, and in a second year his report would be completed! It would be of more value to science than twenty years in a museum working on collections such as this. Neither he nor Mr. Lyman Clark, who had more than five hundred specimens of Echinoderma other than Asteroidea, 117 species in 66 genera, thinks it worth while to consider geographical distribution. There are very few field notes, and the reader will inevitably conclude that the expedition did little collecting work. This is unfortunate, as a knowledge of the whole fauna and flora of the region is essential to an ecological study of any part.

Another report in this series is Prof. S. J. Hickson's revision of the genera and species of the Xenudæ. It is of high scientific importance and of great educational value to future taxonomic workers on sedentary animals. The desirability of field observations is clear, Dr. Manton's note, "not the same species as on Escape Reef", leading to the discovery of a new species. It is also pleasing to see that the British Museum has a good taxonomist to deal with Tunicates in the person of A. B. Hastings, who appears temporarily to have deserted Polyzoa. G. P. Whitley, ichthyologist to the Australian Museum, collected most of the three hundred and fifty specimens of fish, which he assigned to a hundred species, and his field notes are fuller than usual. He remarks that the region is not sufficiently analysed for a synthesis of the geographical distribution of fish. A. A. Livingstone, of the same museum, has 33 species in 20 genera of Asteroidea, but by a slip New Ireland is placed in the Maldives. We would also refer to an excellent study of *Trochus* by the Australian naturalist, F. W. Moorhouse (vol 3). It feeds on algæ, which it rasps off the rocks, and its optimal area appears to be on the relatively bare weather sides of reefs between tide marks, where the water is well aerated and every bare surface is covered by such algæ. Tables of size frequencies and of monthly rates of growth are given. Breeding takes place after two years, the *Trochus* being then about 5.5 cm in diameter, the full size being about 9 cm.

J. STANLEY GARDINER

## Obituary

PROF. WILHELM OSTWALD

**W**ILHELM (FRIEDRICH) OSTWALD, whose death took place on April 4, was the most notable and widely known figure in the history of physical chemistry during the quarter of a century which preceded his retirement from active academic work in 1905. Of this branch of science, in fact, he may quite properly be called the founder.

Born at Riga on Sept. 2, 1853, and educated at the recently established *Realgymnasium* in his native town, Ostwald entered the University of Dorpat in January 1872. In 1877 he became *magister* and *privatdozent*, and in 1878 he obtained the degree of doctor. Three years later, he accepted a call to the chair of chemistry in the Polytechnic at Riga, where he remained until 1887. It was at Riga that Ostwald's amazing powers as an organiser, thinker, investigator, and teacher had, for the first time, free opportunity to unfold themselves and to grow in strength. There he organised his teaching on a physico-chemical basis, and his aim was to train his students to be scientific thinkers. It was to Ostwald's laboratory at Riga that Arrhenius came in 1885, seeking help and sympathetic understanding of his work.

In 1887, Ostwald was invited to fill the chair of physical chemistry at Leipzig in succession to G. Wiedemann, and it was in Leipzig, first in the buildings of the Agricultural Institute and then, from 1897 onwards, in the new Physical Chemistry Institute in the Linnéstrasse, that Ostwald's greatest work as a teacher, writer, investigator, and inspirer of research was carried out, and it was during his Leipzig period that his intellectual and creative powers attained their zenith.

Ostwald retired from his chair at Leipzig in 1905 and, in the same year, he was nominated by the German Emperor as first exchange professor to America. In 1909 he was awarded the Nobel prize in chemistry.

In a short notice it is not possible to give more than an indication of some of Ostwald's scientific and literary achievements. In his work as an investigator, Ostwald, by his own hands or with the help of a large number of students who flocked from all parts of the world to his laboratory, laid the foundations of large sections of physical chemistry. Problems of chemical affinity, strength of acids as determined by density measurements, distribution between bases, effect on hydrolysis of methyl acetate, etc., were the subjects which first attracted his attention, and he discovered, independently of Arrhenius, that the conductivity and chemical activity of acids run parallel. Then came the development of electrochemical studies—electrical conductivity and electromotive force measurements as methods of studying chemical activity, solubilities, etc.—and out of these studies came the dilution law and Ostwald's devotion to energetics. Lastly, in the laboratories at Leipzig, the foundations of the study of catalysis were well and truly laid. By

no other leader in chemical science has such a wide range and variety of scientific interests been manifested.

Great, however, as were Ostwald's experimental contributions to physical chemistry, his work as teacher and as champion of what might then be called the new learning (van't Hoff's theory of solutions, Arrhenius's theory of electrolytic dissociation, etc.) was perhaps of still greater value for the advance of science. An enthusiastic lover of his subject, Ostwald was possessed by the spirit of the missionary and the teacher. To the joy of creating and acquiring knowledge was added the equally great joy of passing on his knowledge and mental outlook to others. Ostwald was a master both of the spoken and of the written word, and once his orderly and clear-thinking brain had arranged his ideas, he could give rapid and unhesitating expression to them in clear and smooth-flowing language. His extraordinary memory, moreover, never failed to supply him with apt illustrations with which to adorn an argument.

In the early days at Riga, Ostwald collected together all that was known in the department of physical chemistry, and so gave to all serious students his "*Lehrbuch der allgemeinen Chemie*" (1885–1887), and in order to promote the study of physical chemistry and to provide an organ for its expression, he founded, in collaboration with van't Hoff, the *Zeitschrift für physikalische Chemie*. From that time, book after book—his "*Grundriss*", his "*Elektrochemie*", his "*Hand- und Hilfsbuch*", his "*Grundlinien der anorganischen Chemie*", his "*Schule der Chemie*", etc.—poured from his pen. To the all-compelling power of Ostwald's personality, to his burning enthusiasm, and to the freshness, breadth, and inspiration of his personal teaching and of his writings, physical chemistry owes a very special debt.

By the end of last century, Ostwald's interest in a specialised branch of science had developed, quite naturally as he felt, into an interest in generalised knowledge or philosophy, and, in 1902, he published his "*Vorlesungen über Naturphilosophie*", which attracted much attention at the time and received the warm appreciation of William James. As was natural with Ostwald, there followed on the publication of his "*Vorlesungen*" the founding of the periodical, *Annalen der Naturphilosophie*. So Ostwald, the apostle of physical chemistry, became the apostle of the doctrine of energy as the fundamental basis of reality.

Although Ostwald had never been much interested in industrial chemistry, he felt it to be his patriotic duty to make his country independent of others for the supply of the nitric acid necessary for the manufacture of explosives, and he turned his attention, therefore, to the production of nitric acid by the catalytic oxidation of ammonia. The process which he developed was the main source of Germany's supply of nitric acid during the War.

Ostwald was a man of large mind and large heart,



he spoke his mind freely and always put forward his views with enthusiasm and conviction, but he neither scorned nor regarded lightly the honestly held views of others. His honesty of purpose, his enthusiasms, his freshness of mind, and the variety of his interests gave to all intercourse with him a charm which impressed all those who had the privilege to partake of it. To his purely scientific interests he added an intense interest in music and painting, and the exercise of these two arts was the means whereby a tired and sometimes overwrought brain became rested and refreshed. To his interest in painting is no doubt due the interest which, during the later years of his life, he took in the theory of colour, his views regarding which he has expounded in his book, "Physikalische Farbenlehre", and in other books and memoirs.

ALEX FINDLAY

#### DR H T FERRAR

THE death of Hartley Travers Ferrar at the comparatively early age of about fifty-two years was announced in London on April 19. Leaving Oundle in 1898, he entered Sidney Sussex College, Cambridge, and took a second class in the Natural Science Tripos in 1901. Besides being captain of his College boat club he rowed in the University trials, and it was when stepping out of an eight at Henley that he was offered a place as geologist to Capt. Scott's First Expedition to the Antarctic. The chief scenes of his labours on the expedition were in South Victoria Land, where the great Ferrar Glacier was named after him.

On his return to Cambridge in 1904, Ferrar was elected a fellow of the Geological Society and spent several months in writing up his observations. Living beneath the same roof with him at this time, and discussing almost daily his many problems, I learned to appreciate—possibly as few could who had not accompanied Scott—those sterling qualities that had enabled him to accomplish so much, and won him so many lifelong friends.

In the autumn of 1905, Ferrar joined the Egyptian Survey and before Christmas had made a long camel trip into the Eastern Desert beyond Edfu. By April 1906 he was in the Western Desert (Siwa Oasis) beginning to interest himself in water-supply. In late 1907 he commenced field-work in Upper Egypt on the movements of subsoil waters, with particular reference to their effects upon cotton and other crops, and this study was extended to Lower Egypt in subsequent years. Results were published as a Survey Department paper in 1911. During 1910–11 he made a series of experiments, in association with the Department of Agriculture, on the effects of movements of the water-table on the cultivation of cotton in the Delta, in the course of which he set out many lines of tube wells and recorded thousands of observations. The experiments proved that there was (up to a limit) a steady increase in the crop yield with increase in the thickness of soil above the water-table. The findings were issued as a Survey Department paper in 1912. During this period also he visited the oil-fields.

Somewhere about 1912, Ferrar retired from the

Egyptian Survey and proceeded to New Zealand, his wife's home country. The outbreak of war saw him in Egypt again, with the New Zealand Forces, and later he became an efficient map-officer attached to the Australian Flying Contingent in Palestine.

In 1919, Ferrar was appointed geologist to the New Zealand Survey (Department of Scientific and Industrial Research) in which he had risen to the position of assistant director at the time of his death. Amongst other publications, an important *Bulletin* (No. 27, New Series, 1925), written mostly by himself, "On the Geology of the Whangarei-Bay of Islands Subdivision, Kaipara Division", describes the results of the survey of 1905 square miles in North Auckland and deals largely with mineral deposits. In his latest outstanding work (*Bull.* No. 33, New Series, 1929), "On the Soils of Irrigation Areas in Otago Central", his Egyptian experiences were invaluable, as shown by his discussion of the irrigation problems. His soils are classified into series, classes and types, and such subjects as climate, drainage, soil-profile, youthful and mature soils are considered.

It was largely on the strength of this last publication that, in February last, Ferrar was awarded the degree of D.Sc. (Diploma) by the University of New Zealand. Besides his official publications, some thirty papers on different subjects were contributed to scientific journals in Great Britain, Egypt, and New Zealand.

In May 1931 old memories were revived when the *Discovery* called in at Wellington on its way to southern latitudes.

BERNARD SMITH

WE regret to announce the following deaths

Dr. Albert P. Brigham, professor emeritus of geology at Colgate University, president in 1918–19 of the American National Council of Geography Teachers, on April 1, aged seventy-six years.

Mr. Donald R. Dickey, a research associate of the California Institute of Technology, who was an authority on the birds and mammals of North and Central America, on April 16, aged forty-five years.

Dr. B. K. Emerson, for forty-seven years professor of geology at Amherst College, and president in 1899 of the Geological Society of America, on April 7, aged eighty-eight years.

Prof. C. S. Hastings, professor and emeritus professor of physics at Yale University since 1884 and a member of the U.S. National Academy of Sciences, a well-known designer of astronomical telescope objectives, aged eighty-three years.

Sir Thomas Legge, C.B.E., for nearly thirty years senior medical officer of factories at the Home Office and afterwards medical adviser to the social insurance section of the Trades Union Congress, who took a leading part in the promotion of industrial health in Great Britain, on May 7, aged seventy years.

The Hon. Dr. William Pember Reeves, formerly Agent-General and afterwards High Commissioner for New Zealand, who was director in 1908–19 of the London School of Economics, on May 15, aged seventy-five years.

## News and Views

### Christopher Borrus

It is a tradition of the Society of Jesus that St Ignatius, its founder, was wont to watch the heavens in order that his heart might be inflamed with the love of God from the consideration of the wonders of His work, and from almost its earliest days the Society has included men who have devoted themselves to astronomy and other sciences. Clavius, Scheiner, Grimaldi, Hell, Mayer, Boscovich, Secchi, and Perry are but a few of the men of science who have belonged to the Society. One of the first, however, was Christopher Borrus, who was born in Milan in 1583, joined the Society in 1601, and died on May 24, 1632, three hundred years ago. Like Fathers Trigault, Rhô, and Schall, he was sent as a missionary to the Far East, and wrote a valuable account of Cochinchina. He made observations on the variation of the compass, and, according to Kircher, drew up the first charts of the Atlantic and Indian Oceans, showing the spots where the magnetic needle makes the same angles with the meridian. He was thus a forerunner of Halley. His explanation of the chart is contained in a manuscript which belongs to the Royal Academy of Lisbon. He also made suggestions as to a new method for determining longitude at sea. After some years spent in the East, he returned to Europe, and taught mathematics at Coimbra. His death took place at Rome shortly after he had entered the order of Cistercians.

### The Varley Brothers

In an interesting address on the brothers Varley, who did much valuable pioneering work in telegraphy and electrical engineering, Col. Lee, of the Post Office, in a lecture on May 5 to the Institution of Electrical Engineers, pointed out that the whole progress of telegraphy during the constructive period up to the laying of the Atlantic cable was largely the history of Cromwell and Samuel Alfred Varley. This year is the hundredth anniversary of the birth of S. A. Varley. Cornelius Varley, the father of the two brothers, was a well-known scientific worker, and delivered the fourth Friday evening discourse at the Royal Institution. He was a descendant of Oliver Cromwell. The first attempts to lay an Atlantic cable having failed, Cromwell Varley served on a committee appointed by the cable company which issued a most valuable report. Later on, Cromwell Varley and Sir William Thomson (Lord Kelvin) entered into partnership as consulting engineers, being joined later by Fleming Jenkin. Cromwell Varley wrote many scientific papers, one of them published by the Royal Society describing experiments on luminous phenomena which came very near to discovering the electron. Samuel Alfred Varley did much valuable work in telegraphy. During the Crimean War, he laid the first field telegraph in 1854. His greatest invention was the self-exciting dynamo, on which he had been experimenting since he was seventeen years of age. On technical

grounds the priority of this invention is generally attributed to others. At the International Inventions Exhibition in 1885, he was awarded a gold medal for inventing a self-exciting dynamo. He championed the cause of the electrical industry against the Brush patent for the compound wound dynamo. Varley's precedence in the invention was upheld after an appeal to the House of Lords and the Brush patent was declared invalid. Both the brothers Varley and the late Earl of Crawford played a leading part in founding the Institution of Electrical Engineers. Among the seventy-one founder members were four of the Varley family.

### Life and Work of Dr. James Murie

DR. JAMES MURIE, well known for his work on the Thames fisheries, was born on March 30, 1832, and he died in 1925. To commemorate the centenary, Mr. A. Lawrence Wells gives an interesting account of his life and work in the *Southend Standard* of March 31 last. Murie is chiefly remembered for his later work at Leigh, where he lived and did valuable service in connexion with the local fisheries, but his early career was full of adventure. Educated for the medical profession at the University of Glasgow and specialising in zoology, he first worked at the Royal Infirmary, Glasgow, proceeding to the Royal College of Surgeons in London as assistant in the Museum, where, under Prof. J. E. Quekett, he worked at comparative anatomy, especially aquatic mammals. After two years at the Museum, he travelled through Europe and made several voyages as ship's surgeon, finally joining the expedition to the White Nile under John Petherick, who was meeting Capt. Speke and Grant for exploration of the western tributaries of the White Nile. The expedition, disastrous as it proved to be as regards Petherick's party, was yet productive of much valuable zoological material, and the fish collection was declared by Dr. Gunther to be the finest ever received from that part of Africa.

On his return to England, Murie again worked at the Royal College of Surgeons, arranging and cataloguing the collection of slides left by Prof. Quekett, then becoming prosecutor for the Zoological Society, and later sub-editor of the Linnean Society's publications. It was whilst working for the Linnean Society that he rented a cottage at Leigh and so began his interest in the Thames fisheries. These various employments no doubt helped in his later work, which he made peculiarly his own. Besides his practical help and constant sea-going with the fishermen, he reported on the fisheries for the Kent and Essex Sea Fisheries Committee, which required much original research. The first part of this valuable report on the Fisheries of the Thames Estuary has been published, the second part, as has been already noticed in *NATURE* (May 14, 1927, March 5, 1932), is partly in proof and partly in manuscript, and the whole is now in the Southend Library.

### New Foreign Members of the Linnean Society

At the meeting of the Linnean Society of London on May 12, the following were elected foreign members.—Prof Klas Robert Fries, director of the Botanic Garden, Stockholm, who has made very important contributions to our knowledge of the flora of South America, chiefly of the Argentine, Bolivia, and Brazil. His work on the tropical American *Anonaceæ*, *Amarantaceæ*, and *Colonnifereæ* (Malvales) and his monographs of *Wissadula* and *Petunia* are especially noteworthy. He has also done valuable work on the flora of Rhodesia, the Congo, etc., and has made contributions to mycology. Prof Eduard Fischer, professor of botany at the University and director of the Botanical Institute, Bern, distinguished for his works on a wide range of mycological subjects since 1883. He has devoted especial attention to the Gasteromycetes, on which he contributed the section in Engler and Prantl's "Pflanzenfamilien". He has produced monographic studies of the Rusts of Switzerland, and carried out extensive studies of the biology of heteroecious rusts. He collaborated with E. Gaumann in the most complete work on the biology of parasitic fungi that has yet been published. Prof Ludwig Jost, director of the Botanical Institute and Gardens, University of Heidelberg, known for his work as a teacher of plant physiology and his influence on the development of his subject. Prof Émile Topsent, professor of zoology and comparative anatomy, University of Strasbourg, the leading authority in the world on sponges. His first paper was published in 1887, since when he has published a number of papers and several important books, including reports for the Prince of Monaco. His large quarto volume—"Campagnes . . .", Monaco, 1928—is the most up-to-date monograph on sponges.

### U.S. National Academy of Sciences

It is announced by Science Service that the following have been elected foreign associates of the U.S. National Academy of Sciences: Marchese Guglielmo Marconi, Prof Karl von Goebel, Munich, Prof H. Wieland, Munich, Prof Fritz Haber, Berlin. Fifteen new members were elected: Dr R. T. Birge, University of California, physics, Dr E. G. Borng, Harvard University, psychology, Dr S. R. Detwiler, Columbia University, anatomy, Dr W. A. Jacobs, Rockefeller Institute for Medical Research, New York City, chemotherapy, Dr D. W. Johnson, Columbia University, geology, Dr L. O. Kunkel, Boyce Thompson Institute, Yonkers, N.Y., plant physiology; Dr K. Landsteiner, Rockefeller Institute for Medical Research, New York City, immunology and pathology, Dr W. C. Mendenhall, U.S. Geological Survey, geology, Dr Marston Morse, Harvard University, mathematics, Dr F. K. Richtmyer, Cornell University, physics, Dr J. C. Slater, Massachusetts Institute of Technology, Cambridge, Mass., physics, J. R. Swanton, Bureau of American Ethnology, Washington, D.C., anthropology, Dr R. J. Trumpler, Lick Observatory, Mt. Hamilton, Calif., astronomy, Dr E. W. Washburn, U.S. Bureau of Standards, and editor-in-chief of International Critical Tables, chemistry,

Dr J. B. Whitehead, the Johns Hopkins University, mathematics and philosophy.

### Jericho

RECENT correspondence in the daily Press on the Exodus and its relation to the fall of Jericho was no doubt to some extent responsible for the interest taken in the account of the third season's excavations on the site of that city given by Prof John Garstang before the Royal Asiatic Society on May 12. Although two seasons' work had produced no certain evidence of dating, Prof Garstang on opening his third season had arrived at an opinion, based on the evidence of stratification as well as the absence of any sign of Mycenaean contact, that the conflagration which destroyed the city, and of which there is abundant evidence, had taken place during the late Bronze Age, probably somewhere about 1400 B.C. With the view of obtaining datable objects which might or might not confirm this view, the Bronze Age cemetery some four hundred yards west of the city mound was attacked and twenty-five tombs were opened and cleared. Objects numbering eighteen hundred, the great majority pottery, were obtained covering the history of the site throughout the Bronze Age. Most significant of all, however, were ninety-four royal Egyptian scarabs, which have been examined by Prof Newberry and pronounced by him to range from the Hyksos period to the reign of Amnhotep III. Egyptian influence first appears about 1500 B.C., but nothing of the Tel el-Amarna period and the age of Akhenaton has been found. It is, therefore, concluded that the city was destroyed at some date between 1411 B.C. and 1375 B.C. Evidence of re-occupation appears in the Iron Age, but the walls were not rebuilt until about 900 B.C.

### Excavation in Southern Palestine

SIR FLINDERS PETRIE briefly summarises the results obtained by the British School of Archaeology in Egypt at Tel Ajjul up to the close of the past season's excavations, in the *Times* of May 13. The results fully bear out his opinion that the early history of Palestine has been more fully explained on this site than on any other in the country. The evidence it has afforded extends from the rock-cut tombs of the Copper Age, c. 3400 B.C., in which copper daggers and pottery were found, to the age of Thothmes III, after whose day the site was abandoned until it was occupied again by Arab squatters in the Middle Ages. No less than five palaces were erected on the limestone hill, of which the limits were artificially extended to take the greater area covered by the later buildings. The first palace was erected by the people who introduced bronze from North Syria and whose invasion founded the Eighth Dynasty of Egypt. The second palace, Sir Flinders Petrie considers, was probably erected by the founders of the Twelfth Egyptian dynasty, while the third and fourth were the work of the Hyksos. The later Hyksos palace has afforded evidence of a foundation sacrifice in which the body of a horse was flung into a pit. Its shoulders and the bodies of two other horses afforded the

material for a sacrificial meal. One of the most noteworthy finds was a gold torque, in form similar to the torque found at Troy and presumably of Irish origin. Lectures on the work of the season are being given at University College, London, on May 19 at 2.30 P.M. and May 21 at 3 P.M., entrance free, without ticket; and the usual exhibition will be open at the College on July 11-Aug. 6.

#### Animals and Electric Shocks

It is well known to electricians that animals are much more sensitive to electric shock than human beings. Quite low voltages, of the order of 20 volts, are dangerous to cattle and horses. About twenty years ago, when rural electrification began to increase on the Continent, fatalities to these animals began to occur, and it was found necessary to devise methods for mitigating the danger. As the electrification of farms has now been begun in Great Britain, the paper by T. C. Gilbert in the *Electrician* for April 29, in which he discusses some of the effective safety devices used abroad, should prove useful. Wiring systems where the 'live' wires are surrounded by metal which is connected to 'earth' are perhaps the safest, at least in towns, where the mains of the water supply system, into which any leakage currents usually flow, form an excellent earth. In rural districts, earths are made by burying metal plates or pipes. In this case the resistance of the earth may be of the order of 50 ohms, and so even if a leakage current be less than an ampere, the difference of potential of the ground near where the pipe is inserted and four feet away may cause a dangerous shock to a large animal standing with a foreleg near the pipe and a hindleg four feet from it. Mr. Gilbert records a very exceptional case where no less than six cows in one farm were killed from this cause. So far as we know, no fatalities to human beings have ever occurred in this way. We have heard of cases where mild shocks have been felt in the street, when a pedestrian steps from one part of the pavement to the other, due to a fault in an underground main. The effective methods used abroad show that the risks to cattle can be made almost negligible.

#### Spore Dissemination through the Upper Atmosphere

DURING the War, aeroplanes came to be used to an increasing extent for the direct investigation of meteorological conditions in the upper atmosphere. We learn from an article that forms one of the "Why the Weather" series, by C. F. Talman, issued by Science Service, Washington, D.C., that the aeroplane is being used in analogous biological investigations by the U.S. Bureau of Plant Industry to determine, among other matters, the height to which the spores of the dreaded black stem rust occur in the American spring wheat area. The spores are collected on glass microscope slides covered with a very thin coating of vaseline. It has been found that they extend up to a height of about 10,000 ft above the earth. From the results of other investigators on the rate of fall in still air of the spores of white-pine blister rust, a spore only slightly smaller than the black stem rust spore,

it may be concluded that the black rust spores would occupy about two days in falling from 10,000 ft to the ground, in the absence of any net upward or downward component of the wind. Since it is no rare event for the wind above the first few hundred feet to travel a thousand miles or more in a day, it is evident that regions lying far to leeward of infected areas may receive spores from these great altitudes.

#### Cave Exploration in Western China

THE United States National Museum has received a large collection of objects which have been obtained from the caves of Szechwan, Western China, by Mr. David C. Graham, of the Smithsonian Institution, Washington, D.C. This explorer has found that a large number of the innumerable caves of Szechwan and the Tibetan border were used as tombs by the Chinese at about the beginning of the Christian era, but no evidence is forthcoming to support the view that they were once inhabited by aborigines who preceded the coming of the Chinese. The caves are generally found in steep places, both singly and in groups. They are difficult of access, and vary in depth from a few feet to 130 feet, being about six feet wide and six feet high. Some show signs of chisel marks. Nearly all the caves have coffin niches, the coffins being of earthenware. Some coffins, however, are merely cavities chiselled in the stone and fitted with stone lids. Among the funerary offerings, the large number of figurines of human form is noteworthy. Some of these in costume and general appearance present a remarkable similarity to the people of to-day.

#### Norman Lockyer Observatory

SIR FRANK DYSON, Astronomer Royal, will open the new Mond photographic equatorial and dome at the Norman Lockyer Observatory, Salcombe Regis, Sidmouth, on May 28. The Norman Lockyer Observatory is the only astronomical observatory in Great Britain founded and maintained by a private corporation under the Companies (Consolidation) Act of 1908. Since it was started, nearly twenty years ago, it has been equipped and maintained entirely by private donations. The equipment includes two twin telescopes, one with a 10 in. object glass and a 12 in. prismatic camera, and the other with a 10 in. object glass and a 9 in. prismatic camera for photographing the spectra of stars and other celestial bodies. A very large collection of such photographs, numbering 6500, has already been taken at the Observatory, affording valuable records of the nature and movements of objects in the stellar universe. Dr. Robert Mond, who has been a generous supporter of the Observatory since it was founded, has now presented a unique photographic equatorial, with a separate building and dome to house it. The instrument consists of a battery of four cameras with clock mechanism, so that it will be possible to follow automatically movements of the heavens over a wide field of the sky.

#### Expeditions of the Soviet Academy of Science

THIS year the Soviet Academy of Science is sending out ninety-nine scientific expeditions to explore

remote regions of the Union, including the Kola peninsula, the Ural-Kuznetsk Basin, Transbaikalia, the Turukhan region, East Sayan, the Irkutsk region, the Minusinsk region, Buriat Mongolia, and Tanu-Tuva, also the salt and soda lakes of the Kulundin steppe in western Siberia. Aeroplane photography will be used to establish the extent of the Siberian forests. The expedition to Kazakstan is to explore the natural resources of the Karagandin, Koundar, and the Dzeskazgan regions of the Altai and Ridder, and to investigate the possibility of reconstructing the agriculture of north Kazakstan. Seventy-five detachments are starting for Central Asia to explore the natural resources of Tadzhikistan, Turkmenia, Uzbekistan, and Pamir. It has been decided to start to explore this year the natural resources of Khirghizia, which possesses much potential hydraulic power and big deposits of ferrous and non-ferrous metals, and has suitable lands for cattle-breeding. The expedition to the Crimea is to concentrate on the exploration of the salt lakes. The expedition to Transcaucasia will examine the possibilities of utilising hydraulic power in the region, that to the northern Caucasus is to explore the deposits of rare elements such as cadmium and the mineral resources of the main ridge of mountains of the region. In Balkaria an investigation will be made of the soil of the mountain grass-lands. To cover the cost of the expeditions, the Government has allocated six million roubles, and additional sums will be supplied if necessary. These expeditions are to follow up previous exploration work carried out by the Academy of Science in the Yakutsk, Buriat-Mongolsk and Transbaikalian regions, which resulted in the discovery of medicinal and other plants suitable for export, and of new areas for rice-growing.

#### Buildings for Science Departments

At the instigation of the British Science Guild, the Royal Institute of British Architects has undertaken an inquiry into the design of science departments with the view of affording guidance in the matter of accommodation, fittings, finishings, and supply services. An elaborate questionnaire has been drawn up in convenient column form asking for particulars of the sizes of rooms for definite numbers of students, their aspect, wall and floor surfaces, and various laboratory fittings considered desirable. Replies are to be sent to Mr. Alan E. Munby, Science Standing Committee, Royal Institute of British Architects, 9 Conduit Street, London, W.1. Science departments, of course, fall into different categories, and the present inquiry is confined to provisions for higher teaching and research and has been sent to the heads of departments of the universities of the British Empire and certain research institutions. Should an analysis of the returns justify it, the Council of the Royal Institute of British Architects may issue a short report which would put architects and engineers into closer touch with the specific needs of science departments. There can be little doubt that, given adequate response, the questionnaire will give designers of new science departments a valuable body of data on which to base their work.

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#### Mice Plague in Australia

PROF W A OSBORNE, University of Melbourne, sends us the following cutting from the Melbourne *Argus* of March 30, dealing with the present mouse plague in Victoria, Australia. "After all wheat had been trucked from the Lah railway station, near War-racknabeal, a raid was made upon the mice. The site was fenced, and two 40-gallon oil drums were sunk in the ground. The dunnage was then cleared and the mice driven into the drums. On the first night the catch, placed on the weighbridge, weighed one ton, and on two successive nights 8 cwt and 10 cwt were caught, the weight for the three nights being nearly two tons." Prof. Osborne informs us that the greatest visitation of these pests occurred in 1917, when enormous stacks of bagged wheat remained in various railway sidings. The plague was first noticed in February and March of 1917, it was at its acme between April and August of the same year. At Lascelles, three tons, approximately 200,000 mice, were caught in one night. Until the end of June 1917, the recorded total caught was 544 tons, at least 32,000,000 mice.

#### International Congress of Scientific Management

THE Fifth International Congress of Scientific Management will be held at the Kolomaal Instituut, Amsterdam, on July 18-23. The subjects to be discussed include costing, markets, technical and mental education of foremen for rationalisation, systems of promotion, rationalisation as a part of education, costs of retail distribution, agricultural labour, and rationalisation in various types of industry. Papers from many countries have been contributed through the national associations or committees and are being published in two volumes in advance of the meeting; summaries only will be read at the sessions of the Congress. Excursions in Amsterdam, to Eindhoven, the Zuider Zee, and to Rotterdam are being arranged, and continental railways are giving special facilities for those attending the Congress. The general secretary for the Congress is Mr V. W. van Gogh, Herengracht 209, Amsterdam—C. English visitors can obtain particulars from the honorary secretary, Institute of Industrial Administration, 44 King William Street, London, E C 4.

#### South-Eastern Union of Scientific Societies

THE thirty-seventh annual Congress of the South-Eastern Union of Scientific Societies will be held in London, at the Civil Service Commission, Burlington Gardens, W.1, on June 1-4, under the presidency of Dr R. E. Mortimer Wheeler. The presidential address, on "Field Archaeology in Great Britain", will be delivered in the evening of the first day of the Congress. The sections, their presidents, and the subjects of the presidential addresses are as follows: archaeology, Dr W. E. St. L. Finny, "Medieval Games and Games"; botany, Mr J. Ramsbottom, "Fungi as Scavengers"; geology, Prof H. L. Hawkins, "The Structure of the South-East of England"; zoology, Mr Hugh Main, "The Camera as a Naturalist's Recorder"; regional survey, Mr G. L. Pepler,

"Town and Country Planning" Evening lectures will be delivered by Sir Arthur Thomson, on "The Drama of Animal Life", and by Capt Guy Dollman, on "Great Game Animals of Africa". There will be an exhibition of regional survey material under the supervision of Miss E W Spear, and a number of excursions of specialised interest, as well as others of more general appeal, have been arranged. The honorary general secretary of the Congress is Mr E A Martin, 14 High View Close, Norwood, London, S E 19.

#### World Power Conference

A SECTIONAL meeting of the World Power Conference will be held in Scandinavia on June 26-July 10, 1933. All countries represented on the organisation are invited to attend and take part in the discussions, which will be mainly in connexion with large factories taking power in bulk and traction. The iron and steel industries, railways, and marine transport will be specially considered. Many attractive excursions have been arranged, and receptions will be held in Copenhagen, Stockholm, and Oslo. A contingent will also make a visit to Finland by aeroplane. In a bulletin issued from the office of the World Power Conference, 63 Lincoln's Inn Fields, W C 2, D N Dunlop, the president of the International Executive Council of the Conference, contributes an interesting article on its functions. He says he has little belief in the ability of politicians and bankers by themselves to solve the problems that at the present moment menace our civilisation. By 1933 the immediate problems will probably have changed, but no real beginning to economic reconstruction can be made until the nations of the world embark on a rational policy for the organisation of production and distribution. The world needs practical vision. Without this, what we have already brought about in the way of technical and scientific co-operation may be swept away. The scientific and technical industries of the world are the result of the creative activity of men of all nations, it is on us that there now falls the task of seeing that this activity is fully utilised.

#### Announcements

THE Lister Medal for 1933 for distinguished contributions to surgical science has been awarded by the Royal College of Surgeons to Sir Charles Ballance, who will deliver the Lister Memorial Lecture at the College on some date in 1933.

It is reported by the Madrid correspondent of the *Times* that a great part of the University of Valencia was destroyed by fire on May 12. Much damage was done, the astronomical observatory and the faculties of natural history, physics, and chemistry, with their collections and laboratories, being destroyed. Most of the contents of the library have apparently been saved.

THE need of qualified people, able to interpret scientific thought and activity so as to make it available

to a larger public, has led the School of Journalism of Paris (part of the Institut des Hautes Études) to arrange a course of lectures on scientific journalism. It is intended both for students and for practising journalists. The lecturer, M René Sudre, scientific editor of *Le Journal*, is well qualified for his difficult task. The journalistic profession will certainly benefit by its realisation that scientific reporting is a branch of journalism that requires special training.

A CATALOGUE (No 19) of some 321 second-hand books on gardening and botany has reached us from Mr J H Knowles, 23A Beulah Hill, S E 19.

THE latest catalogue of Messrs Dulau and Co, Ltd, 32 Old Bond Street, W 1 (No 199), relates mainly to second-hand botanical books and periodicals, herbals, floras, and general natural history. There is also a section of interesting miscellaneous works. Copies may be had free upon application to the publishers.

AN interesting catalogue (New Series, No 27) of upwards of 800 second-hand books on gardening (including herbals), agriculture, and husbandry (1481-1800) has just been issued by Messrs Wheldon and Wesley, Ltd, 2 Arthur Street, W C 2. Many rare volumes are offered for sale, and useful bibliographical notes are appended to some of the titles.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.—A teacher of chemistry for day and evening classes at the Wandsworth Technical Institute—The Secretary, Technical Institute, Wandsworth (May 25). A full-time teacher of engineering subjects at the Acton Technical College—The Principal, Technical College, Acton, W (May 27). A Graham scholar in pathology in the University of London—The Academic Registrar, University of London, South Kensington, S W 7 (May 29). A lecturer in mechanical and aeronautical engineering at the Northampton Polytechnic Institute—The Principal, Northampton Polytechnic Institute, St. John Street, E C 1 (May 31). A lecturer in production engineering in the Department of Mechanical Engineering of the Birmingham Central Technical College, and a lecturer in building and allied subjects in the Department of Building and Structural Engineering—The Principal, Central Technical College, Suffolk Street, Birmingham (June 3). A joint professor of mining in the University of Glasgow and the Royal Technical College, Glasgow—The Secretary, University Court, The University, Glasgow, W 2, or The Secretary, Royal Technical College, Glasgow (June 11). A secretary of the Chartered Surveyors' Institution—The Hon. Secretary, Chartered Surveyors' Institution, 45 Parliament Street, S W 1 (June 20). A Tennent professor of ophthalmology in the University of Glasgow—The Secretary, University Court, University, Glasgow. A woman temporary lecturer in mathematics at the Lincoln Training College—The Principal, Training College, Lincoln. A director of the West of Scotland Neuro-Psychiatric Research Institute, Glasgow—The Secretary, Hawkhead Asylum, Crookston, Glasgow.



### Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

#### Suggested Wireless Observations during the Solar Eclipse of August 31, 1932

At a recent Geophysical Discussion at the Royal Astronomical Society (an account of which has been published in the March issue of the *Observatory*) the possibility of deriving information concerning the nature of the solar radiation responsible for upper-atmospheric ionisation by means of wireless observations made during a solar eclipse was discussed by us. It is known that the agents principally responsible for the ionisation in both of the atmospheric ionised layers travel rectilinearly, so that both ultra-violet light and swiftly moving neutral particles may

the eclipse effects on the two kinds of solar radiation, wireless observations on the equivalent height and reflection coefficient of either ionised region, continued through the eclipse period, are well suited to decide between alternative hypotheses as to the cause of their ionisation, since abnormal effects would be expected in either case, due to the temporary cessation of the production of ions. In the case of ultra-violet light this effect would be most marked in the region of the optical eclipse and immediately after totality, while in the case of neutral particles the maximum effect would occur earlier and in a different region.

In the solar eclipse of 1927 in Great Britain the experiments made by one of us have been interpreted as supporting the view that ultra-violet light is partly if not wholly operative in the lower region, since a partial return to night-time wireless conditions was experienced round about optical totality. But the possibility of fortuitous variations in the ionised layer cannot be entirely ruled out, and it is highly desirable that more numerous observations of a

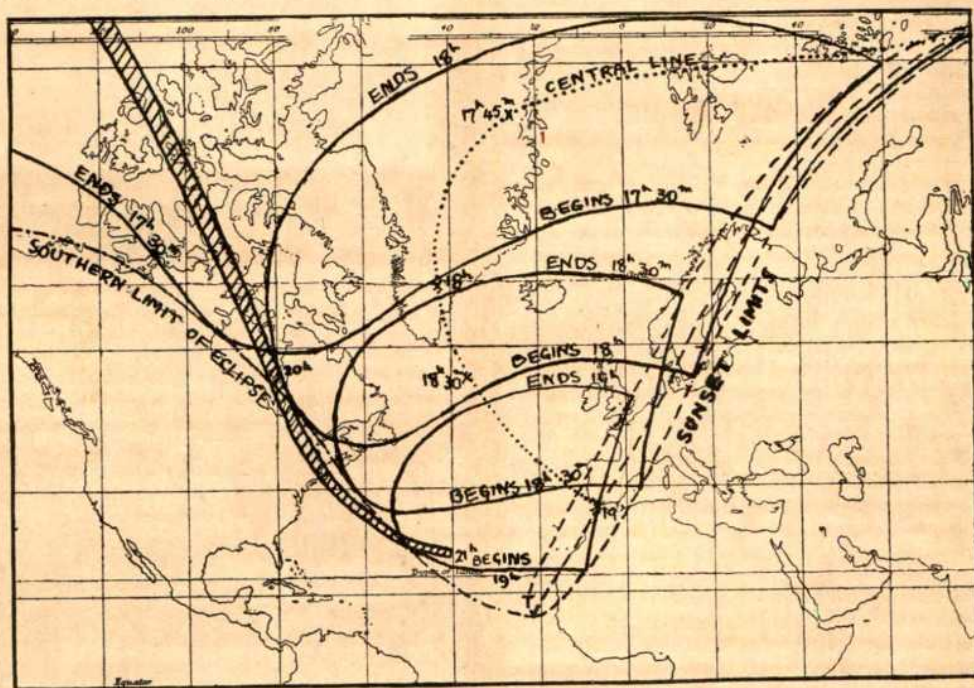


FIG. 1.

be considered as possible causes. Because of the difference in velocity with which these two types of radiation travel, it turns out that there are important differences in the incidence in time and place for what may be called the 'optical eclipse' and the 'corpuscular eclipse', when the moon cuts off the solar stream from the earth.

In consequence of the motions of the moon and the earth, the stream of supposed neutral particles will be interrupted more than an hour before the ultra-violet light is stopped; the eclipse effect on the incidence of the neutral particles may, in fact, be entirely over before the optical eclipse begins. The eclipsed region in the case of the particles will also be much to the east of the optical eclipse track. The difference between the two eclipses, in time and space, will depend on the velocity of the particles; if this is assumed to be 1000 miles/sec., as suggested by E. A. Milne's theory of emission of solar particles, the difference in time is about two hours.<sup>1</sup>

In consequence of the marked difference between

similar character should be made. The known great variability of upper-atmospheric conditions renders it important that check observations should be made outside as well as inside the areas of both optical and particle eclipses.

We wish to direct attention to the excellent opportunity afforded by the solar eclipse of Aug. 31, 1932, for testing this point. By the courtesy of the Royal Astronomical Society, we are enabled to reproduce here a map (Fig. 1) made by Mr. J. C. P. Miller, in which the corpuscular eclipse on this occasion is indicated, on the above assumption as to the speed of the particles. The eclipsed region, at various times, and the central line, are shown; all the times are G.M.T. The shaded band is the track of optical totality. Special wireless observations at a site on the track of the optical eclipse are to be made in Canada under the joint auspices of the Canadian National Research Council and the Physics Department of McGill University, Montreal, but these should be supplemented by observations at as wide a network



of stations as possible within or near the belt of the corpuscular eclipse.

We shall be glad if anyone who is able to make observations of either a simple or more ambitious character on this occasion will communicate with the first mentioned below. In this connexion we may add that, in the case of the 1927 eclipse, wireless observations of great value were obtained with apparatus of modest character, a simple galvanometric record of signal intensity being obtained.

E. V. APPLETON.

Wheatstone Laboratory,  
King's College, London.

S. CHAPMAN.

Imperial College of Science  
and Technology, London.

<sup>1</sup> *Monthly Notices*, R.A.S., vol. 92, March 1932, pp. 413-422.

### Photodichroism Produced by $\alpha$ -Particles

A PHOTOGRAPHIC plate of specially prepared fine grain emulsion, exposed to plane polarised light, gives rise on development to a dichroic deposit of silver. This effect, discovered by Weigert,<sup>1</sup> appears to have a vital bearing upon theories of formation of the latent photographic image.

It would seem that a silver deposit might exhibit dichroism for one of two reasons: (a) the silver grains are scattered at random but are all oriented with their longest axis pointing in one direction, the direction of the electric vector of the original light which produced the dichroic image; or (b) the silver grains are oriented at random but are so distributed as to be arranged more densely in one direction than another, the direction of closest packing being that of the electric vector of the original light.

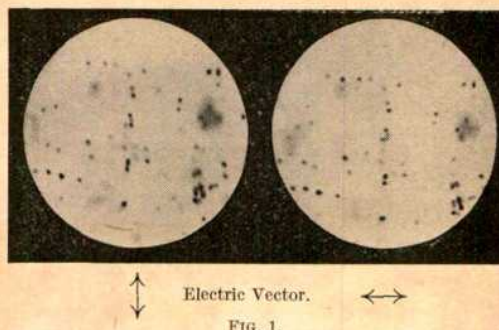
If it be held that the latent image is produced as a result of ejection of a photoelectron by the absorbed quantum of light, then the selective photoelectric effect, in which the emission is a maximum in the direction of the electric vector of the incident light, may be invoked to explain the Weigert effect, and the silver deposit will owe its dichroism to condition (b) above. Further, it might be expected that in the presence of a strong magnetic field parallel to the incident light, the production of dichroism might be diminished or destroyed. This effect was looked for by Cotton<sup>2</sup> without success, and accordingly he abandoned the explanation.

Although examination of the dichroic silver deposit with high magnification fails to show any evidence for either (a) or (b), as the grains are too small for complete resolution, yet it is possible to produce, artificially, a deposit of silver grains in which the distribution is linear and approximates to condition (b), by bombarding the photographic plate with  $\alpha$ -particles at a small glancing angle. With very fine grain plates each  $\alpha$ -particle produces a track<sup>3</sup> consisting of a number of silver grains depending upon the residual range on impact. The spacing of the grains in a single track varies, but on the average, for the particular photographic plate used, their centres are about 0.5 micron apart. They are in a medium (gelatine) of refractive index about 1.52, so that their separation is rather larger than a wave-length of yellow light, which is rather less than 0.4 micron in such a medium.

Seen under a microscope with a twelfth of an inch oil immersion objective and a magnification of 25, the individual grains in the  $\alpha$ -particle tracks are well resolved when the electric vector of the light by which they are seen is perpendicular, and poorly resolved when it is parallel to the length of the track. This is

well shown in the photomicrographs (magnification 1350 times) in Fig. 1. In other words, the light transmitted through the gaps between adjacent particles in the  $\alpha$ -ray track is polarised with the electric vector perpendicular to the track.

To test this further, a fine grained photographic plate was exposed for equal periods to an intense polonium source of  $\alpha$ -rays, so that on development two adjacent portions of the plate had silver deposits of equal density, one with the  $\alpha$ -ray tracks in one direction, and the other with the tracks in the direction at right angles to the former. The two deposits were thus formed of silver grains of which the directions of closest packing were mutually at right angles. Under these conditions it was possible to observe a very minute but distinct dichroism of the silver deposit, the optical density of the deposit being greater



when the electric vector of the incident light coincided with the direction of the  $\alpha$ -ray tracks, that is, with the direction of closest approach of the silver grains.

It is thus possible to produce dichroism with a known condition of arrangement of the silver grains, and it would seem that the second explanation of the photodichroism produced by excitation with plane polarised light is the correct one; this would lend support to the idea that the selective photoelectric effect plays a direct part in producing the photographic latent image. Further experiments are being conducted, and the results will be published in full later.

A. M. TAYLOR.

The Institute of Optics,  
Rochester, New York,  
March 3.

<sup>1</sup> Weigert, *Z. wiss. Phot.*, **30**, 95 and 177; 1931.

<sup>2</sup> Cotton, *C.R.*, **189**, 599; 1929.

<sup>3</sup> M. Blau, *Ber. Akad. Wiss. Wien*, **139**, 2A, 328; 1930.

### Stark Effect for Argon

THE Stark effect on argon lines has earlier been investigated by E. Böttcher and F. Tuczek<sup>1</sup> and by W. Steubing.<sup>2</sup> These investigators have worked with relatively small electrical field strengths, 26 kv./cm. and 38 kv./cm. respectively, and could not observe any effect. Using higher field strengths ( $E_{\text{max}}$  about 170 kv./cm.), T. Takamine and N. Kokubu<sup>3</sup> succeeded in showing some very small displacements, towards the red of the violet lines, belonging to the so-called 'red spectrum' of argon, the structure of which was unknown at that time. The series analysis of this spectrum was given by K. W. Meissner<sup>4</sup> and F. A. Saunders.<sup>5</sup> From this we now notice that the affected lines observed by Takamine and Kokubu all belong to the principal series. It was to be expected that these lines would be very little displaced, whereas on the subordinate series lines a greater influence of the electrical field would be anticipated. Probably owing to deficient intensity, these lines have



not been observed. For this reason I made an attempt to investigate the electrical effect on these lines.

The source of light was a Lo Surdo tube of the same type as earlier described by me.<sup>6</sup> The light was analysed by a plane diffraction grating spectrograph, constructed by Prof. J. Koch. The grating, having an effective surface of 8 cm.  $\times$  5 cm., was ruled at the National Physical Laboratory at Teddington. Using autocollimation according to Littrow, the light from the slit was made parallel by a large Zeiss Tessar

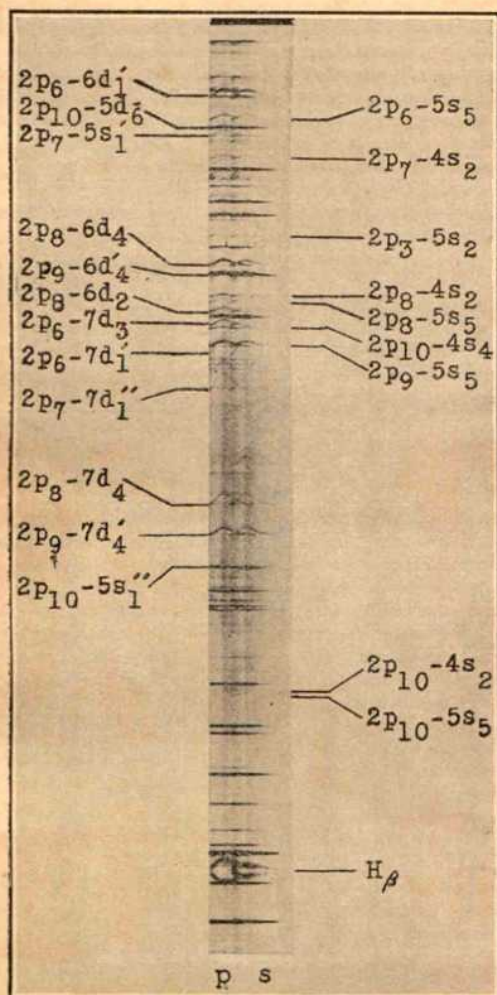


FIG. 1.—Spectrum of argon (dispersion about 14 Å. per mm., magnification about 14), maximum field 92.7 kv. per cm.

with 60 cm. focal distance and by the same lens system focused on the photographic plate. Thus brilliant spectra were produced in the first and second order. One of the photographs obtained is reproduced in Fig. 1. The maximum field strength, as determined from the Balmer lines of hydrogen, present in the discharge tube, was 92.7 kv./cm. About ninety lines, belonging to the subordinate series, have been observed in the region  $\lambda\lambda 6500-5100$ , and nearly all of them show greater or smaller displacements, the main part of them towards the red.

Compared with the electrical influence on the analogous spectrum of neon that was earlier investigated,<sup>7</sup> the displacements of the energy levels of argon in electrical fields are considerably smaller. This is intimately bound up with the hydrogen differences. The diffuse subordinate series terms  $m d_i$  and  $m s_i$ <sup>(1)</sup>

(according to the notation of Paschen for the neon terms) have appreciably larger hydrogen differences than the corresponding neon terms. Thus the magnitude of the displacements is in agreement with the rule that greater displacements correspond to smaller hydrogen differences, and conversely. The greatest shifts are observed at the most hydrogen-like terms  $m d_2$ ,  $m s'_1$ ,  $m d'_1$ , and  $m d''_1$ , whereas the terms  $m d_6$ ,  $m d_5$ ,  $m s'_1$ ,  $m s''_1$ , and  $m s_1$  with the greatest hydrogen differences are the least affected. Among these terms the  $m d_6$  are quite unaffected. For the main part of the terms, the term value decreases in the electrical field. Only two of the observed terms,  $6d_5$  and  $5s_1$ , increase with the field.

The large hydrogen differences give rise also to another phenomenon predicted by the theory, namely, that the displacements of the terms are proportional to the square of the field strength. This may be observed at several terms. The general view of the Stark effect for argon is quite different from that observed in the helium or neon spectrum. In the latter, the diffuse series lines are accompanied on the violet side by combination lines of the type  $2p_i-mf$ ,  $2p_i-mg$ , etc., forming characteristic groups. There are no such groups in the argon spectrum. The position of the  $2p_i-mf$  lines may be computed from the known terms,<sup>8</sup> but no combination lines at all have been observed with certainty. Among the  $s_i$  terms ( $i=2, 3, 4, 5$ ) a great number have been investigated. They all decrease with the field strength and the displacements are remarkably large. The investigation is being carried on, and a more detailed account is to be published elsewhere.

NILS RYDE.

Physical Institute,  
University of Lund, March 8.

- <sup>1</sup> *Ann. Phys.*, **61**, 107; 1920.
- <sup>2</sup> *Phys. Z.*, **23**, 427; 1922.
- <sup>3</sup> *Proc. Math. Phys. Soc., Tokyo*, **9**, 405; 1918.
- <sup>4</sup> *Z. Phys.*, **37**, 238; 1926; **39**, 172; 1926; **40**, 838; 1927.
- <sup>5</sup> *Proc. Nat. Acad.*, **12**, 556; 1926.
- <sup>6</sup> *Z. Phys.*, **71**, 124; 1931.
- <sup>7</sup> J. S. Foster and W. Rowles, *Proc. Roy. Soc.*, **123**, 80; 1929.
- <sup>8</sup> N. Ryde, *Z. Phys.*, **59**, 836; 1930.
- <sup>9</sup> E. Rasmussen, *Naturwiss.*, **18**, 1112; 1930.

#### The Auroral Spectrum in the Infra-Red

PROF. L. VEGARD<sup>1</sup> has recently reported the observation of two infra-red lines or band-heads in the auroral spectrum, namely,

a strong one at  $\lambda 7883 \pm 12$  Å.  $\nu 12682 \pm 20$  cm.<sup>-1</sup>,  
and a weak one at  $\lambda 8095 \pm 12$  Å.  $\nu 12350 \pm 20$  cm.<sup>-1</sup>.

Pointing out that, since the spectrum shows bands of the  $N_2$  second positive system strongly, it might also be expected to contain bands of the  $N_2$  first positive system, Prof. Vegard calculates the positions of three bands of the latter which are within a few Ångström units of the stronger auroral line  $\lambda 7883$ , and points out that one of the three corresponds to an improbable transition, but leaves open the question as between the other two.

The main object of the present letter is to correct the numeration used in Prof. Vegard's, and eliminate another one of the three calculated bands.

Poetker's observations<sup>2</sup> in the far red and near infra-red region of the first positive system required a revision of the vibrational quantum numeration first given by Birge<sup>3</sup> and now employed by Prof. Vegard. The correct numbering is obtained by diminishing Prof. Vegard's  $n_2$  by unity to give  $v'$ , his  $n_1$  being identical with  $v'$ . Birge's revised band-head formula<sup>4</sup> is

$$\nu_{\text{head}} = 9518.59 - (1718.40v' - 14.437v'^2 - \dots) - (1446.46v'' - 13.929v''^2 - \dots),$$

and the  $v', v''$  numeration of the three bands calculated



by Prof. Vegard is: 1, -1 ( $\lambda 7885$ ), 7, 6 ( $\lambda 7896$ ), and 12, 12 ( $\lambda 7863$ ). The first of these is meaningless. The third is improbable, since 12, 12 is remote from the course of the Condon intensity curve in the  $v', v''$  scheme of the band system. Only the 7, 6 band need therefore be considered. A band near the computed 7, 6 position was observed in  $N_2$  by Croze<sup>5</sup> at  $\lambda 7887$ ,  $\nu 12676$  and by McLennan, Smith, and Peters<sup>6</sup> at  $\lambda 7894$ ,  $\nu 12666$ ; both of which are within the observational error of Prof. Vegard's strong auroral line or band-head.

The  $N_2$  first positive band nearest to the weak auroral line or head,  $\lambda 8095$ , is the 6, 5 band observed by Poetker at  $\lambda 8047.2$ ,  $\nu 12423.2$ ; the difference is much bigger than the estimated error of observation of the former; this therefore remains unidentified.

The idea of the presence of  $N_2$  first positive bands in the auroral spectrum is not new. About ten years ago, I think, Lord Rayleigh (unfortunately I cannot now turn up the actual paper) suggested that the auroral line or band  $\lambda 6320.1$ ,  $\nu 15818$ , might be identified with one of the first positive bands which appear especially strongly in the spectrum of active nitrogen, namely, the 10, 7 band  $\lambda 6321.1$ ,  $\nu 15815.7$ .

W. JEVONS.

Military College of Science,  
Woolwich, April 28.

<sup>1</sup> NATURE, 129, 468, March 26, 1932.

<sup>2</sup> Phys. Rev., 30, 812; 1927.

<sup>3</sup> Phys. Rev., 23, 294; 1924; and N.R.C. Bulletin, No. 57.

<sup>4</sup> Int. Crit. Tables, 5, 415; 1929.

<sup>5</sup> Comptes rendus, 150, 860; 1910.

<sup>6</sup> Trans. Roy. Soc. Canada, 19, 39; 1925.

### Sound-change and Indeterminism

THE recent tendency towards indeterminism which is apparent in the natural science of to-day raises the question whether it would not be equally profitable to adopt a somewhat similar attitude in considering the most difficult of all the problems of the science of philology: Why do changes in language take place? In this letter I wish to put forward the suggestion that, of those sound-changes usually known as 'spontaneous', in which one sound of a language (which we may call  $X$ ) gradually changes to another ( $Y$ ), some at least may be due to pure chance. At a given period in which the sound  $X$  is present in the language let us consider the pronunciation of the children learning to acquire this sound. While the majority will acquire a pronunciation  $X$  identical with that of the earlier generation, some will acquire slightly 'erroneous' pronunciations ( $X'$ ,  $X''$  . . . etc.), that is, pronunciations differing slightly from that of the majority.

In attempting to explain changes of the type considered here it is usually assumed that, at the moment when the change is commencing, there is some *a priori* reason (physiological or otherwise) why there should be a tendency towards a particular erroneous pronunciation; in this case towards a pronunciation  $X_1$ , erring slightly in the direction of the sound  $Y$ . I suggest, however, that the change can be explained without the assumption of such an *a priori* reason. We know, from the theory of probability, that, even if there is no such *a priori* reason, the erroneous pronunciations  $X'$ ,  $X''$  . . . etc. will not be equally represented. But so long as the number of speakers with any one of these erroneous pronunciations is not abnormally high, there can be no tendency towards a change in the sound  $X$  in the language as a whole. Suppose, however, that by chance we have an exceptionally high proportion of speakers with the erroneous pronunciation  $X_1$  (just as we might have an exceptionally long 'run' on one

colour at roulette), then in a comparatively short space of time the pronunciation  $X_1$  may become the prevailing one; in other words, a change of  $X$  to  $X_1$  will have taken place.

Let us now consider the conditions at this stage of the language. As before, there will be a certain proportion of speakers with erroneous pronunciations ( $X_1'$ ,  $X_1''$  . . . etc.); of these, let us consider two:  $X$  (which has now become erroneous) and  $X_2$  (erring still further in the direction of  $Y$ ). If the proportion of speakers with any one of these erroneous pronunciations is not abnormally high, there can be no tendency towards a further change. If the proportion of speakers with the erroneous pronunciation  $X$  is, by chance, exceptionally high, this may again become the prevailing one; in this case  $X_1$  will change back to  $X$ . If, on the other hand, the proportion of speakers with the erroneous pronunciation  $X_2$  is abnormally high, there may be a change of  $X_1$  to  $X_2$  and a stage nearer  $Y$  will be reached. Thus, given a favourable 'run', it may easily happen that finally  $Y$  itself is reached via the stages  $X_1$ ,  $X_2$  . . . etc. In this way the change of  $X$  to  $Y$  can be explained as being due to pure chance. Of spontaneous sound-changes, therefore, some may be due to an *a priori* cause and others to pure chance, and the latter possibility should always be borne in mind in the investigation of these changes.

ALAN S. C. ROSS.

The University, Leeds,  
March 24.

### Crystal Lattice Distortion in Stretched Wire

THE process of cold-rolling or drawing certain metals is known to produce a permanent irregular departure from the normal atomic structure of the grains. I find that this type of lattice distortion occurs also in wires of constantan which have been stretched longitudinally by gradual loading. The degree of the distortion increases most rapidly as the yield-point is approached. Nickel, copper, and most alloys examined give similar results.

The criterion of true lattice distortion is a broadening of the lines in the X-ray spectrum formed by reflection of monochromatic X-rays. A change in breadth is indicated in a sensitive manner by the state of resolution of the  $K\alpha_1$ ,  $\alpha_2$  components of the incident radiation. The  $\alpha_1$ ,  $\alpha_2$  doublets reflected by the (420) and (331) planes of constantan, photographed under identical conditions, are shown herewith. Fig. 1, A, is taken of the initial wire; and Fig. 1, B and C, of the wire under increasing load. It is clear by comparison that as a result of the tension the doublets in Fig. 1, A, diffuse into unresolved bands, and thereby illustrate the production of lattice distortion. This structural change will call for some consideration in any theory of the changes of properties of wires under tension.

A simple practical proof that these observations indicate lattice distortion and not a very fine-grained structure, which also causes diffusion of X-ray spectra,

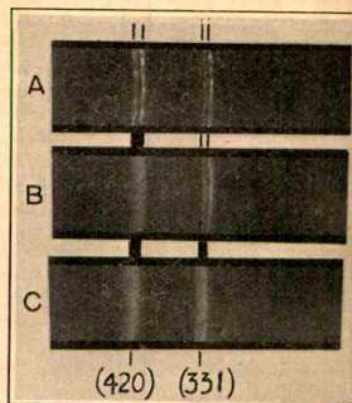


FIG. 1.



has been highly desirable. Such evidence is provided by Fig. 1, B, where (1) the (420) is diffused even while the (331) line is still a sharp doublet, despite the addendum (2) that the (331) occurs at the small reflection angle where the resolution on geometrical grounds is much less. Now this means, on the small crystal theory, that the dimensions of the grains in the [331] directions are large ( $c 10^{-4}$  cm), whilst in the [420] directions they are very small ( $c 10^{-7}$  cm). These two aspects are mutually contradictory. Therefore the small crystal hypothesis is here untenable.

A similar differential resolution of the doublets has been found well marked in rolled  $\alpha$ -brass

W A WOOD

Physics Department,  
National Physical Laboratory,  
Teddington, Middlesex,  
April 18

### The True Weight of Benzopurpurin 4B, and the Electrical Conductivity of its Aqueous Solutions

A PAPER has recently been published by Robinson and Mills<sup>1</sup> in which certain properties of Benzopurpurin 4B are precisely defined. The concentration of the solutions has been determined by these authors by drying in an oven at 105° C.

The purpose of this communication is to point out that many direct cotton dyestuffs are so extremely hygroscopic that one or two per cent of moisture remains at this temperature. In the course of exact work in this laboratory on the absorption of direct dyestuffs by cellulose, Benzopurpurin 4B (amongst other dyes) has been prepared in a pure state, and the apparent dry weight determined under various conditions, with results of which the following are typical

|                                                   | I     | II    |
|---------------------------------------------------|-------|-------|
| Relative wt air dry                               | 113.6 | 114.4 |
| „ „ dried in 110° oven for 24 hours               | 101.7 | 101.5 |
| „ „ dried at 110° C <i>in vacuo</i> over $P_2O_5$ | 100.0 | 100.0 |
| „ „ in 110° oven again                            | 101.5 | 101.7 |

The moisture content of this substance, and of the other direct dyestuffs so far examined, appears to vary continuously with the relative humidity of the surrounding atmosphere (R.H. in 110° C oven is of the order 1 per cent). It appears, therefore, that the electrical conductivities and other constants given by Robinson and Mills will be in error by about 1.9 per cent, the approximate moisture regain at 105° C.

The general principles of the drying of hygroscopic substances at high temperatures are illustrated in a paper, "The Dry Weight of Cotton", by Davidson and Shorter<sup>2</sup>

S M NEALE  
J HANSON

Chemistry of Cellulose Laboratory,  
College of Technology,  
Manchester, March 24

<sup>1</sup> *Proc. Roy. Soc. A*, 131, p. 576, 1931

<sup>2</sup> *Shirley Inst. Mem.*, 8, p. 197, 1929

### Formation of Periodic Precipitates in the Absence of a Foreign Gel

RECENTLY many workers<sup>1</sup> have reported on the formation of periodic precipitates in the absence of another gel. We have obtained periodic precipitates in the slow coagulation of sols of ferric hydroxide, chromic hydroxide, and stannic hydroxide by small quantities of univalent electrolytes like potassium chloride and sodium bromate. Freshly precipitated ferric hydroxide was peptised by the minimum quantity of acetic acid, which was then boiled off, the sol was further purified

by hot dialysis. The concentration of the purified sol was 39.2 gm per litre. The chromic hydroxide sol was obtained by adding ammonium carbonate solution to hot chromic chloride and then purified by continuous hot dialysis. The concentration of the purified sol was 32.5 gm per litre.

We obtained the stannic hydroxide sol by peptising stannic hydroxide (freshly precipitated from stannic chloride and freed from chloride) with ammonia and afterwards driving it off by boiling. The sol contained 12.4 gm of  $SnO_2$  in a litre.

These observations can be explained from the theory of periodic precipitation given out by Dhar and Chatterji.<sup>2</sup> The theory states that periodic precipitation is caused by the adsorption of the sol by the precipitate of the same substance, hence, according to this theory, periodic bands are obtained only when the sol and the precipitate co-exist. In the present case, when the sol is coagulated slowly by the addition of small quantities of univalent electrolytes, the sol and some of the precipitate coagulated from it exist together for a sufficient length of time. Hence adsorption of the sol by its precipitate occurs, giving rise to periodic bands. On the other hand, when the sol is rapidly coagulated by the addition of large quantities of electrolyte, the sol soon passes from the sol to the precipitate condition. The sol and the precipitate thus do not co-exist for a sufficient length of time. Hence no ring formation takes place.

It will be interesting to note in this connexion that we could not obtain periodic precipitates by the coagulation of the same sols with polyvalent electrolytes.

N R DHAR  
R N MITTRA

Chemistry Department,  
University of Allahabad

<sup>1</sup> *NATURE*, 128, 1042, Dec. 19, 1931, 129, 205, Feb. 6, 1932.

<sup>2</sup> N. R. Dhar and A. C. Chatterji, *J. Phys. Chem.*, 28, 41, 1924; *Kolloid Zeit.*, 37, 3, 89, 1925; *Z. anorg. Chem.*, 159, 120, 186, 1926.

### Winter in the Ionosphere

IN a recent Geophysical Discussion at the Royal Astronomical Society,<sup>1</sup> I suggested that there is evidence of a close connexion between the mechanisms of ionisation of the Kennelly-Heaviside and Appleton regions of the ionosphere. The evidence depends on coincidences in the annual variations of received long and short wave signals.

Hollingsworth<sup>2</sup> reported a very abrupt change in received signal intensities measured at Slough, Manchester, Glasgow, and Aberdeen, and in polarisation measured at Slough, on wave-lengths of more than 10,000 metres, "during the last week of October and the first week of November 1924". The new mean values attained at this onset of the radio winter were maintained "until the beginning of May 1925", although the May change was much less spectacularly abrupt than the November change. The phenomenon, which I have called the Hollingsworth anomaly, was repeated at the end of October 1925, and it was shown that the primary characteristic of the radio winter is the persistence of abnormal polarisation throughout the hours of daylight.

Wilkins, observing here daily from July 1931, was receiving radio telephone signals from Rome and Sardinia on the ultra-short wave-lengths of 10.06 metres and 9.8 metres respectively with fair regularity until Nov. 1, 1931. From that date no signals in the ten-metre region were heard, despite daily observation.

Hollingsworth was undoubtedly dealing with waves returned from the lower parts of the Kennelly-Heaviside region—he had in fact measured the equivalent height of reflexion as about 75 km—and Wilkins was almost equally certainly concerned with an electron

limitation effect in the upper part of the Appleton region, the electron density even in the most heavily ionised part of this region having become insufficient to 'reflect' the very high frequency waves even at grazing incidence. My suggestion was, then, that the very striking coincidence in date between the two phenomena pointed to a similarity in the mechanism of ionisation in the two regions, which must not be overlooked in discussion of the rival claims of ultra-violet light and corpuscles as the effective agents for one region or the other.

The argument is now very notably reinforced by the fact that Wilkins again heard the 10.06-metre signals from Rome, and heard also signals on 10.02 metres from Oslo (the third harmonic of a telegraph station) on May 2, 1932, daily observations throughout the ionospheric winter thus so accurately delimited having failed to give any trace of signals between Nov. 2 and May 1. The signals from Sardinia (9.8 metres) reappeared on May 6. We are without detailed long-wave data for 1931-32, but it should be remarked that 1924-25 and 1931-32 are approximately symmetrically disposed about the somewhat indefinite 1928-29 maximum of the present solar cycle, so that the comparison here made is the next best thing.

It would be unwise to infer forthwith an identical mechanism for the two regions, but clearly both involve agencies of solar origin, and both have curves of annual variation in which a six months' 'summer' gives place to a six months' 'winter', and vice versa, on dates common to the two regions. The dates are somewhat oddly displaced relatively to the astronomical reference points of solstice and equinox, yet they suggest a twelve-monthly variation rather than one related to the two equinoctial maxima of magnetic disturbance.

R. A. WATSON WATT.

Radio Research Station,  
Slough, May 10

<sup>1</sup> *The Observatory*, March 1932, p. 80.  
<sup>2</sup> Radio Research Board, Report for the period ended March 31, 1929, p. 34.

### The Tectonics of the Albertine Rift

It has been represented to me that misconception with regard to this matter, so far as my own views are concerned, may arise in consequence of my passing, without comment, some remarks made by Prof. J. W. Gregory in his able review of Prof. Bailey Willis's book, "Living Africa".<sup>1</sup> Gregory quotes my early description of the local rift valleys correctly thus: "fracture valleys running along linear upwarps".<sup>2</sup> That was the view I put forward in 1921, but we have learnt a good deal since then, and Sikes pointed out to me, in 1925, that the faults I invoked to explain the Albertine rift are of a type difficult to accept, because of the immense depths from which they would have to emerge. I agreed; but this in no way weakened my general thesis. Writing to my friend Prof. Arthur Holmes, I afterwards suggested that the rift fractures rose from nearly flat soles, after the manner of the highland thrusts, but he at that time was unable to agree, and I delayed publishing this view until further evidence should be forthcoming, and then, in 1928, Bailey Willis produced his ramp hypothesis to explain the Dead Sea Valley—an explanation more complete but essentially similar to that which I had suggested to Holmes to account for the Albertine depression and the high scarps bordering it. I adopted the ramp explanation, as I stated, in Pretoria in the following year.<sup>3</sup>

That the Albertine Rift did not originate along the crest of a linear upwarp has now been clearly demonstrated by our studies of the riverine history of

Uganda, for it is found that the eastward drainage away from the present escarpment did not commence until the rift valley appeared, and is an inversion consequent upon the uprise of the valley sides, nor did this occur at the inception of the rift. The main reversal indeed was not until late-middle or post-middle Pleistocene times, when renewed movement gave us the present scarp topography.

It is interesting to note that further evidence in support of the compression hypothesis is provided by recent petrological studies. It is brought out by Holmes and Harwood's work on "The Petrology of the Volcanic Fields East and South-East of Ruwenzori, Uganda",<sup>4</sup> and still more strikingly by A. W. Groves in some as yet unpublished work on rocks in the rift valley zone in Uganda, wherein he shows that crushing becomes increasingly pronounced as the rift is approached, and reaches its maximum in mylonisation in the neighbourhood of the faults. I have Dr Groves's permission to mention this.

E. J. WAYLAND

Geological Survey Office,  
Entebbe, Uganda,  
March 8

<sup>1</sup> *NATURE*, 128, 89, July 18, 1931.  
<sup>2</sup> *Geog. J.*, 74, p. 133.  
<sup>3</sup> Vol. 2, *Compte rendu*, XV International Geological Congress, South Africa, 1929, pp. 323-353.  
<sup>4</sup> *NATURE*, 128, 977, Dec. 5, 1931.

### An Inherited Abnormality in Rhode Island Red Poultry

A SEMI-FEATHERLESS condition, associated with dwarfism, occurs in several breeds of poultry. It is usually attributed to some food or vitamin deficiency. Dakin and Hamilton described specimens in 1928 and suggested that the condition might be due to sub-thyroidism.<sup>1</sup>

In 1929 certain facts suggested to us that the abnormality might be an inherited character, and breeding experiments were undertaken. Three Rhode Island Red males of this type were reared and at about eleven months old appeared to be practically normal. They were mated to normal hens and produced chicks of both sexes showing every conceivable degree of the abnormality. Some were almost completely naked even at six months old, whilst others seemed almost normal throughout. Both sexes showed the abnormality, but the most extreme cases were nearly all males. All the extremely abnormal specimens died, but the less abnormal of these  $F_1$  individuals survived, and the best of the females were mated to a male from a normal stock. This mating also produced chicks of both sexes showing every degree of abnormality. The worst of the  $F_1$  females which survived were mated back to the parent cock to test whether such a mating would produce living offspring. The percentage hatched was as high as in a normal stock, and again every conceivable degree of the abnormality was produced.

That the condition is not due to infection or other environmental factor is practically certain, for a few birds from an unrelated stock, hatched and reared at the same time under the same conditions, showed no sign of the abnormality. It appears certain, therefore, that the condition is inherited, but the exact mode of its inheritance is not yet known. It is apparently not sex-linked.

RUTH C. BAMBER (MRS BISBEE).

Zoology Department,  
University of Liverpool,  
April 1.

<sup>1</sup> *Proc. Zool. Soc.*, London, 1928.



## Research Items

**Ancient Egypt and Medieval Europe.**—Interesting parallels are drawn between certain customs of ancient Egypt and those of medieval and even modern Europe by Mr L B Ellis in *Ancient Egypt*, 1931, pt 4. The 'rearing feast' given to workmen in Westphalia by the owner of a newly erected house, finds its counterpart in the sacrifice offered in ancient Egypt for the workmen who had built a tomb. The splendour of the burial equipment of Tut-Ankh Amen is not far removed in spirit from that which was responsible for the burial of Henry II of England, according to Matthew Paris, in royal robes, crown, ring, gloves, boots of gold-work, gilt spurs, and sceptre and sword, while a bishop or abbot was buried in full vestments, and a bishop of the eleventh century had with him his liturgical comb, with which he had smoothed his beard as he approached the altar. The use of the canopic jars for the storing of the viscera is paralleled by the separate burial of the heart and of the viscera of Eleanor of Castile, and of the heart of Prince Arthur, son of Henry VII. The desire of the medieval devout to be buried, or to have a tomb, in Palestine, takes the form in Egypt of burial at Abydos, or failing that, the erection of a tomb or stele. The concern for burial in both instances is shown in the arrangement for the tomb during lifetime, as Henry VIII contracted with Torrigiano for his tomb in Westminster Abbey. The effigies on Egyptian tombs show grandparents, parents, children, grandchildren, friends, and even a favourite dog. On Elizabethan and Jacobean tombs, married couples appear with their progeny, even those who have died in infancy. Similarities in funerary inscriptions are very close, even when the Egyptians compare themselves with their gods. Rekhmara was "Thoth in judgment, the image of Ptah, the equal of Khnum", while Lady Cope D'Oyley, ob 1633, was "Rebecca in grace, in heart an Abigail, in works a Dorcas, for the church a Hanna, and to her spouse Susanna, prudently simple, providently wary, to the world a Martha and to Heaven a Mary".

**Cuna Indians' Conception of the Soul.**—The significance of certain words current in the religious and magical beliefs of the Cuna Indians of Panama has recently been discussed by Baron Erland Nordenskiöld (*J. Americanistes*, N S, 24). One word, *purba*, may be translated soul, but it has a multiplicity of meanings. It, or rather an aggregation of *purbas*, is a man's double, and leaves his body at death. A very old chant speaks of a man's *purba*, and of the *purbas* of his hair, his fingers, his heart, etc., leaving the body while his *purba* sits at the foot of his hammock weeping. Innumerable dangers assail it on its journey to the Empire of the Dead, where it lives for the future very much the same life as on earth, but in better and happier conditions. In some cases of illness the *purba* is carried off by demons to the home of the demons, and unless it is brought back in time the patient will die. It is common for the Kuna to speak of events witnessed by the *purba* during sleep. Thus one man saw his daughter, who had died while quite young, and, with her, her five children who had been born in the spirit world. Animals have *purbas* which are generally men, though sometimes they are animals. The *purbas* of plants are women. Stones, the sun, and other inanimate objects have *purbas*, and the *purbas* of books, newspapers, etc., burnt in front of the hut of a sick man serve to divert the attention of evil spirits who come to do him harm.

**Feeding Habits of the Zebra-fish.**—In the first number of this year's *Bulletin* of the New York Zoological

Society (vol 35, p 31), C M Breder gives an account, illustrated with photographs of the manoeuvres of the zebra-fish (*Pterois volitans*) of the Indian Ocean in capturing prey. On the introduction of a small fish into its tank, the fish, which is vertically striped with black and white, began to wave its long exerted fin-rays, very slowly and not in unison. When the small fish came to investigate, and was in most favourable position in front of its foe, it was snapped up. Later on the zebra-fish took a more active part and would itself approach prey, waving its fin-rays, the prospective victim did not move off, but swayed from side to side in the water as if dying. This went on until the two were about an inch apart, when the small fish was seized by its foe, from which it might easily have escaped, as the zebra-fish is not adapted to active chasing. The explanation of this behaviour on the part of the prey may perhaps be the dazzling effect of a pattern of narrow stripes, which affects even the human eye, and in this connexion it may be noticed that the barred pattern in hawks is especially characteristic of the active bird-killing genera, and is rare among those which feed on prey where dazzling would be ineffective.

**Sex-linked Inheritance in Ducks.**—Having previously shown how the facts of sex-linkage in fowls could be turned to economic account, Prof R. C. Punnett (*J. Genetics*, vol 25, No 2) has now found that the same principle can be applied to the breeding of ducks. When the common mallard (*Anas boschas*) is crossed with the Indian runner duck, the male ducklings are uniformly of a darker olive-brown than the females, thus enabling the sexes to be distinguished at an early age. When the mallard is the male parent, the ducklings of both sexes are alike and resemble the mallard. The  $F_2$  from this cross gave two male dark brown, one female dark brown, one female light brown. The runner duck came from the East nearly a century ago, and differs markedly from the mallard in body-shape and carriage. It lays many eggs but does not brood them, while the broodiness of the mallard is dominant in the  $F_1$  birds, as is also its habit of taking to flight. The runner is not observed to fly (see also NATURE, 126, 757, Nov. 15, 1930).

**New Observations on *Cephalodiscus*.**—Up to the present, sixteen species of *Cephalodiscus*, some of them of doubtful validity, have been described. The *Discovery* Expedition collected examples of five species, two of which are described as new by C C John (*Discovery Reports*, 3, 223-260, 1931). The greater part of this material was obtained in the neighbourhood of the Palmer Archipelago, the Falkland Islands, and South Georgia. The observation of Andersson (1907) that the living zooids of *Cephalodiscus* come out of the coenocœcium and creep, using the disc as a sucker, on the surface of the colony is confirmed by observations made on living specimens by Dr Stanley Kemp. Two kinds of zooids are present in *C. hodgsoni*—red zooids, with twelve arms, which are females, and brown zooids, with ten or eleven arms, which are males. In *C. densus* a gill sac lies between the external gill opening and the pharynx. The collar pores, which have thick walls and are ciliated, lead by short canals into their respective collar cavities and control the water-currents which maintain the turgidity of the collar and arms. The author notes that during the development of a bud the notochord is very conspicuous. In *C. densus* the heart is situated not on the tip of the notochord, as in *C. dodecalophus*, but on its ventral

surface, so that the pericardium extends backwards almost parallel to the notochord. The evidence suggests that the dorsal vessel, which gives off two branches—the pharyngeal vessels—which enter the gills, conveys blood from the heart to the gills, arms, and proboscis, and that the ventral vessel returns blood to the heart. An account is given of the details of the vascular and nervous systems and of the characters of the four subgenera (one new) and of the eighteen known species. It would have been helpful to the reader to have the magnification of the figures stated.

**Spike Disease of Sandal**—A study of the initial infections of spike disease in a large number of sandal plantations suggested that proximity to cultivated land tends to bring out the disease ("Investigations on the Spike Disease of Sandal, III—Report of Progress to Sept 30, 1931" Indian Institute of Science, Bangalore). This suggested a study of the host range of the disease, and a wide variety of plants is being raised for this purpose. Entomological work has taken the unique form of compiling a list of some eight thousand species of insects normally found on the sandal tree, their relation to the disease in question has yet to be tested. Laboratory experiments show that arginine and cystine are present in greater quantities in healthy plants than in diseased, whilst histidine and lysine are less abundant in the healthy specimens. The pamphlet is intended primarily as a progress report for forest officers, but more technical details of the work will ultimately be published in the *Journal of the Indian Institute of Science* or in other scientific periodicals.

**Enzyme Distribution in Growing Tissues**—The micro-method of measuring minute quantities of amino-acid recently developed by Kinderström-Lang and Holter has now been applied by them (*C R Lab Carlsberg*, 19, No 6) in determining the rate of breakdown of peptides by sections (200  $\mu$  thick) cut from the roots of germinating barley. Their results are of considerable interest in that they show a maximum rate of peptide hydrolysis about 0.8 mm behind the root tip, that is, in the region of elongation. This result is obtained when either leucyl-glycine or alanyl-glycine is employed as substrate, but the rate of hydrolysis of the former decreases more rapidly than that of the latter. In barley leaves, on the other hand, peptidase activity was less and also less variable, but it showed a steady increase from the tip of a leaf to its base.

**Recent Earthquakes in the United States**—*Earthquake Notes*, for Dec 1931, issued by the Eastern Section of the Seismological Society of America, contains some brief notes on recent earthquakes in the United States. The most important shock was that of south-west Texas on Aug 16, 1931. Though the maximum intensity, observed at Valentine, did not exceed 8 (Rossi-Forel scale), slight damage occurred over a large district, and the shock was felt over an area of nearly 450,000 sq miles, of which rather more than half lay in Texas and the rest in Mexico. The first analysis of the seismograms places the epicentre in about lat 29° 9' N, long 104° 2' W, or fifty miles or more to the south-east of Valentine. The Western Ohio earthquake of Sept 20, 1931, had an intensity 7 at Anna, Botkins, and Houston, and disturbed an area of about 40,000 sq miles. From a study of the few seismograms available, Father Johat, S.J., found the epicentre to lie on the south side of, and close to, Anna.

**Effect of Pressure on Weston Standard Cells**—The effect of pressure on the e.m.f. of the Weston cadmium cell, which was investigated up to 1000 atmospheres

by Cohen and Sunnige in 1909, has been followed up to 12,000 atmospheres by T. C. Poulter and C. Ritchey (*Phys. Rev.*, March 1). The experiments, which were carried out in pressure cylinders with cells contained in glass, beeswax, or rubber, confirm the older work well over the common range of the two investigations, a pressure increase from 1 atmosphere to 1000 atmospheres is accompanied by a rise in e.m.f. from 1.018 to less than 1.026 volts. For higher pressures, the results for both 20° and 30° C lie on a single smooth continuation of the initial curves up to about 4000 atmospheres, but beyond this, while the 30° curve continues on its original course, the 20° curve rises much less rapidly, and shows little change in e.m.f. between 6000 and 10,000 atmospheres. Insufficient data exist to correlate the changes with the properties of the components of the cell, but it is clear that the effect can be neglected for most ordinary conditions of operation.

**The Hall Effect in Weak Fields**—The first part of the physics section of vol 2 of the *Memorie* of the Royal Academy of Italy contains a memoir by Drs M. Cantone and E. Bossa on the Hall effect, particularly in weak magnetic fields. The fields are provided by coils without iron and range from 0.020 to 800 gauss, the field of the earth being compensated. The Hall effect is amplified by the use of valves and can be measured to  $10^{-10}$  volt. In neither iron nor nickel is the effect proportional to the field below 6 gauss, but above this field the increment of the effect is nearly proportional to the increment of the field. Neither the two metals nor their alloys show hysteresis in the effect. For four samples of bismuth, for tellurium, antimony, silver, gold, platinum, palladium, aluminium, cadmium, zinc, tin, lead, tantalum, and magnesium, proportionality of effect and field holds from 0.020 to 800 gauss, while for copper, particularly if heated to a dark red and slowly cooled, proportionality ceases at 20 gauss. Compression of iron or nickel produces little change of the effect at low fields but a considerable change at high X-rays produce considerable change of the effect in non-magnetic metals.

**A Large Permanent Magnet**—Most of the work on the separation of  $\beta$ -rays into groups with definite energies has been done by curling up their paths in the field of an electromagnet, but now that cobalt steel, with its special properties, is available, it has become practicable to use permanent magnets, and the design of an instrument for this purpose has been published by J. D. Cockcroft, C. D. Ellis, and H. Kershaw (*Proc. Roy. Soc.*, April). It looks like an ordinary large electromagnet superficially, but the magnetising coils are used only to produce the desired remanent magnetisation. The weight is one ton, and with an air gap of 5.5 cm and pole faces of 500 sq cm area, a maximum field of 2300 gauss is obtainable. The initial expense is greater than for a similar electromagnet, but there is considerable subsequent saving in power. So far, it has been used only for fields of a few hundred gauss, which it has held constant to better than one part in two thousand for several days. The great advantage of the instrument for radioactive work is that it obviates the laborious control of the current of an electromagnet, but, from the account given, it also appears to be as easy and rapid to change fields with this as with the electromagnetic type.

**Spontaneous Ignition Temperatures**—An important symposium on this subject took place recently at the Institution of Petroleum Technologists. Mr F. A. Foord, Air Ministry, described the experiments carried out by Messrs W. Helmore and F. C. Code Holland, at the Royal Aircraft Establishment, on the ignition

characteristics of liquid fuels and chemical factors tending to accelerate their combustion. Although their conclusions were on the whole indefinite, they have shown that the problem bristles with difficulties no less complex than those associated with detonation, on which so much work has already been done, they stated, however, that the spontaneous ignition temperatures of heavy fuels are one of the chief factors affecting smooth running, ease of starting, and the general life of the engine in which they are used. Mr J. L. Chaloner gave an account of the determination of these temperatures by various German investigators in the past, and showed that, summarily, there seemed to be considerable divergence of opinion as to whether they were indeed any criterion of the behaviour of a fuel in an engine, with specific reference to the fuel knock, obviously, in methods of experiment differing so widely as they have done, it is difficult to arrive at generally acceptable conclusions, while even the merit of the Jentzsch tester, the only developed type of spontaneous ignition meter available, has been called into question. Mr L. J. Le Mesurier made useful comparisons of these temperatures with starting and ignition delay tests in engines, and insisted on the essential need of developing a flexible design of testing unit to ascertain its behaviour under all possible conditions, with the view of accumulating data for setting up requisite standard test conditions covering each broad class of commercial engine.

**Precision Photographic Equipment**—The firm of Leitz has recently made considerable improvements in the Leica camera. This little camera takes 36 pictures on one spool of standard-sized cinematograph film. Each picture is 36 mm  $\times$  24 mm. In the latest model, a focal-plane shutter is fitted, this is auto-

matically wound up when the film is moved for the next exposure, so that double exposures are impossible. Interchangeable lenses may now be obtained varying in aperture from  $f$  2.5 to  $f$  4.5 and in focal length from 3.5 cm to 13.5 cm. In addition to a direct vision view-finder, a tiny range-finder is fitted on the camera itself. The range-finder is coupled to the focusing mechanism of the lens, so that while the range is determined the camera is automatically focused. This coupling arrangement operates for each of the interchangeable lenses. A 'depth of focus' scale is engraved on the mount of each lens so that the depth of sharp definition at any distance and setting of the diaphragm is indicated. There should now be no difficulty in obtaining film packed specially for this camera, as both the Kodak and Selo companies are issuing film wound on special spools, and one of them is packing the film on spools which admit of daylight loading and unloading. A very extensive series of accessories specially designed for the Leica camera includes developing apparatus, printers, enlargers, projectors, stereoscopic attachment, and many others. Three accessories deserve special mention: after unscrewing the lens and its mount, the camera may be attached to a microscope in such a way that visual focusing may be carried out up to the moment of exposure; with another set of apparatus, photographs of small objects may be made at natural size, half size, or one-third size; lastly, a special apparatus for taking snapshots of surgical operations can be supplied, this is arranged with a special telescopic view-finder so that, after previous setting, the apparatus may be carried towards the object until the latter is sharply defined in the view-finder, the camera is then in focus, and its field of view is exactly the same as that observed in the finder.

### Astronomical Topics

**The Delporte Planet**—A Science Service *Bulletin* of April 18 describes the views of Drs F. L. Whipple and L. E. Cunningham on this object. They have obtained a value of the period as approximately 3 years, which does not differ greatly from Dr. Kahrstedt's value of  $2\frac{3}{4}$  years. But they prefer to call it a comet, not a minor planet, on the ground of its rapid decline in brightness, which certainly was much greater than would be expected in a planet. They still suggest that the body is identical with the comet Tuttle-Giacobini, seen in 1858 and 1907. The writer of this note held a similar view when the body was first discovered, but has abandoned it, on the ground that the observations of the comet of 1858 will not admit of a period much less than six years, while the present period is less than three years. Jupiter is the only planet that could produce such a great change of period, but if Jupiter had been the cause of the change, the orbit would still pass close to Jupiter's orbit, which it does not. The least distance between the orbits is about two units.

**Mars during the Last Two Oppositions**—*L'Astronomie* for April contains a paper with this title, by M. E. M. Antoniadi, whose long-continued studies of this planet are well known. He notes that there were some nights of superb definition. That of Sept. 20, 1909, was the best within his experience, his view of the planet with the great Meudon refractor on that night is described as a veritable revelation. The region to the south of the Syrtis Major had the appearance of being clothed with herbage, some regions, resembling forests, had a darker hue, the whole being studded with small white dots. Reference is made to a similar description by Prof. Barnard, using the Lick

refractor, in 1894, and it is stated that fine detail has also been seen at Mt. Wilson. The article is illustrated with numerous drawings, which bring out certain changes that were noticed in various regions.

**Greenwich Observations, 1930**—This annual volume has recently been published, it does not contain any change of system as compared with preceding years. The new sidereal clock, Shortt No. 3, was brought into use on April 1, its daily gaining rate was then 0.12<sup>s</sup>, it diminished steadily to 0.06<sup>s</sup> at the end of the year. The time service is based on observations with a small reversible transit instrument, reversed on every star, as the time derived from the transit-circle appears to have a systematic error. The reductions were carried out to 0.001<sup>s</sup>, and included the short-period lunar nutation terms, the star-places of Prof. Enchelberger's catalogue were used. The mean correction to the tabular longitude of the moon (Brown's tables) was +5.08" from observations of the limb, and +5.40" from observations of the crater Mosting A. The correction for the sun (Newcomb's tables) was +1.64".

Observations of solar flocculi with the spectro-helioscope form a new section of the volume, the quantities given are radial velocity, size, and distance and direction from neighbouring sunspots, also the distance of these from the central meridian, observations were made on 65 days, beginning with April 10. The volume also contains the magnetic observations, made at Abinger, and the meteorological observations. There are also measures of 176 double stars, observed with the 28-inch equatorial between 1922 and 1931, all were observed on at least three nights.

### Scientific Management in Industry

FEW documents can give a clearer idea of the ramifications of rationalisation in industry to-day than the annual Report of the International Management Institute (2 Boulevard du Théâtre, Geneva). The Report for 1931, which has recently been issued, although confined to the work and internal administration of the Institute, indicates that in spite of the difficulties created by the economic depression, the interest in scientific management and rationalisation is steadily expanding and the Institute's endeavours to realise the resolutions of the World Economic Conference of 1927 are having important results.

The relation of rationalisation to the economic crisis has attracted much attention, and, in Austria, Dr Ernst Streeruwitz has issued an important survey of rationalisation in relation to world economy, while the urgent need for economy in many quarters has raised the question of extending rationalisation methods to public administration. The drastic curtailment of public expenditure since 1930 has in many countries taken place on unscientific and hazardous lines, and the reductions are likely, while seriously decreasing the efficiency of the public services concerned, to produce no lasting economies.

Practically no machinery yet exists for the comparative study of public administration, and in most countries the idea of a special planning section continuously engaged in the improvement of great departments of State has yet to be born. Even in large scale industry, knowledge of the principles of organisation and administration is often only superficial. Useful activities are curtailed, while waste which would pay their cost many times over proceeds elsewhere unchecked. Even in the twentieth century, administrators still tend to perform surgical operations with an axe rather than with a scalpel.

The value of the Institute in this field, where widespread research is urgently required, is illustrated by the fact that the Institute receives every month more than 800 periodicals dealing with every phase of rationalisation in every country of industrial importance, and in addition, some hundred books and pamphlets are added monthly to its library. The analysis of these sources of information enables the Institute to avoid the incompleteness which characterises some of the reports included in "The Social Aspects of Rationalisation", issued by the International Labour Office.<sup>1</sup>

Certain aspects of the work of the Institute, including its association with the World Social Economics Congress at Amsterdam, its own annual discussion conference, and with the Department of Industrial Co-operation, organised for the first time under Section E at the centenary meeting of the British Association, have already been noted in our columns. In addition to this, various publications dealing with "Scientific Management in a Small Group of Factories", "Railway Systems their Organisation and Management", etc., have been distributed to members, and work has been carried out for the League of Nations, the International Labour Office, the International Committee for Scientific Management, the International Federation of Consulting Engineers, and the International Chamber of Commerce.

The report demonstrates clearly that there is a widespread and definite desire for an international clearing-house of information on rationalisation. Within its narrow resources, the Institute has greatly increased the efficiency with which it is meeting that need, and the work has been increasingly accomplished by means of subscribed income. The limits of administrative economy have, however, been reached, but it appears almost certain that with continued support from its founders for a further five years, the Institute should become self-supporting so far as its general services are concerned.

The continued services of the Institute are of real importance for the more rational arrangement of the world order in the interests of the general community. As the report rightly observes "Only by patient research leading to the gradual enlargement of exact knowledge can the world hope to win a more perfect control over the economic organisation of the machine processes which progress in the physical sciences has developed so rapidly during the past century." To persuade men of all nations to adopt a more scientific outlook on economic problems is the fundamental purpose of the Institute, and, forbidden by its statutes to participate in current political controversies, it has sought to facilitate the discovery of the essential facts or laws of the situation upon which alone, and not on political theory or dogma, a modern industrial community can effectively organise its social and economic life.

<sup>1</sup> Studies and Reports, Series B, Economic Conditions, No. 18

### The Idu (Japan) Earthquake of 1930

IN the accompanying map (Fig. 1), the principal faults formed during the Idu earthquake of Nov. 26 are indicated by broken lines, the most important being the Tanna fault, running nearly north and south. In the Tanna tunnel that crosses the fault 525 ft below the surface, the west side was shifted 7 ft 10.5 in to the south relatively to the other side, the movement on the surface, however, being distinctly less. In the recent number of the *Bulletin of the Earthquake Research Institute* (vol. 10, pp. 261-263, 1932), the results obtained from the renewal of the trigonometrical survey are given. The earlier survey was made in 1925-26, the later in Feb.-March 1931, so that the displacements measured may fairly be attributed to the Idu earthquake. They are represented in direction and magnitude by the arrows on the map, and they show that, as in the Californian earthquake of 1906, both sides were displaced, the west side to the south and the east side to the north.

Near the middle of the Tanna fault, the triangulation point at Daiba on the west side was shifted 28 in to the south, and that at Kurodake on the east side 39 in to the north, the sum of the two displacements being 5 ft 7 in. It is worthy of notice that during the previous interval, 1884-1925 (including the Kwanto earthquake of 1923), the whole peninsula drifted to the north, the point at Sano being displaced 103 in to N 70° E, that at Daiba 24 in to N 7° W, that at Osaka 46 in to N 18° E, and that at Enasi 48 in to N 47° E.

Some very interesting observations have recently been made by Mr. R. Takahasi on the movements of crust-blocks in the Tanna tunnel (*Bull. Earthq. Res. Inst.*, vol. 9, pp. 435-453, 1931). The object of his measurements was to determine if movements of the crust-blocks continued after the great earthquake, possibly with some of the numerous shocks that followed it. Bench-marks were fixed to

the concrete wall of the tunnel, in both west and east sections, at intervals of 20 metres, and their displacements were measured on six occasions, the last four series (on Feb 5-12, March 3-9, April 13-18, and July 18-24, 1931) being the most accurate. Though the changes are very minute, the curves that represent the displacements are remarkably similar. It is interesting also to notice that the principal changes occur in the sections crossed by faults or in which the strata suddenly change in strength, such weak lines forming the boundaries of crust-blocks.

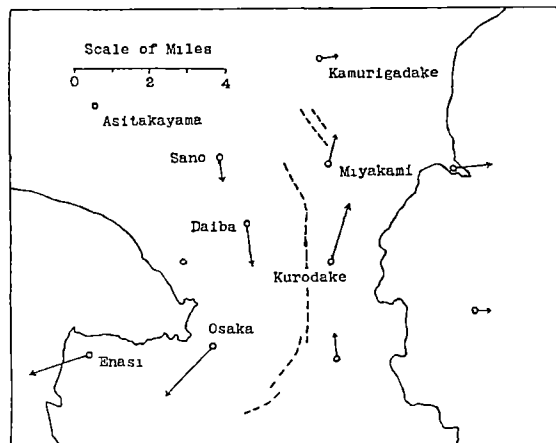


FIG 1

It has long been known that an earthquake may be destructive on the surface ground while, in a tunnel below, it may pass almost, or quite, unnoticed. Mr N. Nasu has recently provided us with some useful measurements on this subject (*Bull. Res. Inst. Earthq.*, vol 9, pp 454-472, 1931). During the Idu earthquake, a few cracks were made in the walls of the Tanna tunnel. Otherwise it was unharmed, though in a village above, 55 per cent of the houses were destroyed. Mr Nasu placed two similar seismographs, one in the tunnel and the other on the ground above, the rock being of the same nature at both places. During the six months that followed, fourteen strong or moderately strong shocks were recorded.

If the period of the vibrations was less than one second, the amplitude was always more than twice, in one case 4.8 times, as great on the surface as in the tunnel. If, however, the period was as much as 4 or 5 seconds, the amplitudes at both stations were almost exactly equal.

Prof. Imamura and Mr. Kodaira have described some seiches that were observed in the lake of Asinokko in the northern part of the epicentral area shown in Fig 1 (*Japan J. Astr. Geoph.*, vol 9, p 115-125, 1932). The lake runs nearly north and south and is about 3½ miles long. The limnograph near the southern end of the lake was thrown out of action by the earthquake at 4.3 A.M., but at 7.20 A.M., when it was repaired, seiches of unusual size were recorded, the amplitude at 9 A.M. being 3.5 in. and the period 6.68 min., showing that the seiches were bimodal. On several other occasions, seiches were observed, usually on the days preceding swarms of earthquakes, for example, on Nov. 16, 19, and 20, when the numbers of fore-shocks on the following days were 64, 530, and 624, and on Dec. 1, 6, and 9, the numbers of after-shocks on the following days being 240, 286, and 592. The authors suggest that the seiches were caused by tiltings of the ground, which are known to precede the occurrence of earthquakes.

The tilting of the ground under different conditions is well illustrated in two recent papers (*Bull. Earthq. Res. Inst.*, vol 10, pp 130-144 and 145-170, 1932). In both cases, the instruments used were horizontal pendulums known as Ishimoto tiltmeters. Mr W. Inouye describes the movements at the observatory of Mt. Tukuba. The short-period fluctuations, as well as the daily and seasonal variations, are connected with changes in air temperature, an increase in which causes a decrease in the inclination of the mountain-side. Earthquakes generally occurred when irregular fluctuations of short period interrupted the long period variations or when the directions of the earth-tilts were changing. Observations of earth-tilts were made at Ito and Kawana in the Idu peninsula from March 19 until July 12, 1930, in connexion with the swarm of earthquakes at Ito during the spring of that year. Mr R. Takahashi shows that the tilts observed at Kawana must be attributed to changes in the tidal load, though there is some discordance, for which it is difficult to account, between the directions of the observed and calculated tilts.

### The British Iron and Steel Industry

AMONG the great industries of Britain which are suffering most from the abnormal conditions of trade is the iron and steel industry, regarding which, for various reasons, many erroneous views are held. The basic facts and circumstances of the industry are described by Prof. W. A. Bone in an article in *Chemistry and Industry* for April 8, entitled "A Survey of the British Iron and Steel Industry, 1913 to 1929 and 1930-31." Referring first to a misleading view expressed in an editorial in the *Observer* for Dec. 6 last, on the changes in the relative position of the iron industry in the United States, Germany, France, and Great Britain, and the effects of fiscal policy, Prof. Bone says, "The truth is that the changes so indicated have inevitably resulted from natural causes combined with human invention and post-War territorial changes, quite independently of any fiscal conditions, and that no change in our fiscal policy can or will prevent the natural course of events."

The supersession of puddled iron by Bessemer and open-hearth steel, the opening up of immense deposits of iron ore in America, the working of the 'basic' process in Germany, the retrocession of Lorraine to

France, and the comparative leanness of the iron ores of Britain are all factors which have led to other countries outstripping us as makers of iron and steel. Smelting and steel manufacture are, however, but two stages in the production of such things as railways, ships, bridges, and motor cars, and the really important question is: Which will pay us best to make, iron and steel or articles from partly imported materials?

Surveying the last nineteen years, Prof. Bone deals in turn with (1) production in 1913 and 1929, (2) a valuation of British iron and steel outputs in 1929, (3) imports of iron and steel raw materials and products in 1913 and 1929, (4) exports of iron and steel materials and products, (5) the slump since 1929, and concludes with some general considerations. In a series of valuable tables, he gives both the tonnage and the value of imports and exports, and from these it is seen that in 1913 the value of all the iron and steel products and manufactures exported from Great Britain was £111,775,000, the value of the corresponding imports was £36,175,000, leaving a balance in our favour of £75,600,000. The corresponding figures for

1929 were £160,930,000, £60,304,000, and £100,626,000. In 1929 the slump set in, affecting all the main iron and steel producing countries alike, and the world production of steel fell from 118,300,000 tons in 1929 to 93,330,000 in 1930 and 69,590,000 in 1931. In the United States, with its high tariff, the fall was no less than 54 per cent. At the conclusion of his survey, Prof Bone remarks that, "in view of the foregoing facts, which demonstrate beyond dispute not only how great has been the value of our vast export trade in iron and steel commodities within recent years, but also the ineffectiveness of tariffs to protect a country against the effects of a world-wide 'slump', the Government may well hesitate about adopting any measures calculated to raise steel prices to home consumers." "Some temporary measure of relief may be necessary to tide over the present emergency, but such measures should be safeguarded so that the dependent export industries shall not suffer through enhanced prices."

### The Plant in Relation to Water\*

THE study of plant life in arid regions has more than an academic interest. It throws important light on the relation of plants in general to their water supply. All things being equal, the plant is most valuable to man either as a crop or as forage when it gives the greatest yield with the least expenditure of water.

An arid region is not constantly hot and dry. It is one of extremes of climate. Plants growing there are not always faced with water shortage, at times they have enough and to spare. Nor are they always growing under a high temperature, extremes of cold have to be met as well as heat. The plants growing in dry regions are not of uniform type but very varied. A large proportion of the species are not drought resistant at all, and grow flowers during occasional dry spells, then die off. The succulent type, familiar through the cacti, with great stores of water which they expend very slowly, are peculiar and very rare in the natural flora of many dry countries. In Australia they are practically absent, and it is only a strictly limited area of light rainfall country that is threatened by the pest pear, not the great arid areas in South, Central, or Western Australia. The seriousness of the prickly pear is its menace to land that is good pastorally, not the danger to the more arid parts.

The various hard-leaved shrubs and trees of the dry country flora are plants of a type suited to climatic extremes. A curious feature of the Australian flora is that the shrubs and trees over most of the continent are of the hard-leaved type. This is the case even in the Sydney district, where the rainfall is good and the loss by evaporation annually is less than the rainfall. The hard-leaved structure does not mean that these plants are necessarily economical of water all the time, but that they can undergo more or less prolonged dry periods without injury.

In studying the drought resistance of various crop and fodder plants, some surprising results have emerged so far as the water requirements are concerned, thus, lucerne is about three times as lavish with its water as is sorghum in order to produce the same weight of dry material. The fact is that no single basis for drought resistance is known. The success or failure of a plant for economic purposes cannot be judged by its economical use of water alone. Even more important is its ability to remain active while water is running short and to survive dry spells.

\* From the presidential address to the Linnean Society of New South Wales delivered by Prof T G B Osborn on March 30.

### University and Educational Intelligence

CAMBRIDGE—Dr G P Bidder has given 5000 lire, with the promise of a like sum next January, for the benefit of the occupants of the Cambridge table at the Zoological Station at Naples.

Mr N F Mott, of Gonville and Caius College, has been appointed University lecturer in the Faculty of Mathematics.

The General Board has, on the recommendation of the Faculty Board of Mathematics, conferred the title of Stokes lecturer in mathematics on Dr P A M Dirac.

DUBLIN—Dr T J Nolan, State Chemist, Irish Free State, has been appointed professor of chemistry in University College, Dublin. Dr Nolan took over his new appointment on May 1.

MANCHESTER—The honorary degrees conferred at the commemoration of Founders' Day included the following—D Sc Sir James Jeans, LL D Lord Rutherford, Sir Arthur Salter, and Dr W D Ross.

OXFORD—The preamble of the statute establishing a final honour school of geography was moved in Congregation on May 10 by Mr C G T Morison, student of Christ Church, and carried without a division. Mr Morison laid stress on the necessity of an adequate scientific equipment for candidates in the school, with the view of providing which many different bodies have had to be consulted. The establishment of this examination will remove certain disadvantages under which graduates of Oxford have suffered in comparison with those of other universities.

THE Rockefeller Foundation, New York, U S A, has published the twentieth series of "Methods and Problems of Medical Education." It deals with many departments of study in medical schools in all parts of the world. The volume contains a number of admirable illustrations of the buildings and laboratories described, in many cases accompanied with plans to scale. The articles are not copyrighted, and may be reprinted or utilised in any manner without permission.

THE first award of the Swan Memorial Scholarship, established as a national memorial to Sir Joseph Wilson Swan, will be made this year by the council of the Institution of Electrical Engineers. The Swan Memorial Fund, the interest from which is devoted to the scholarship, was subscribed through the initiative of a committee composed of representatives of the County Borough of Sunderland, which was Swan's birthplace, and the Institution of Electrical Engineers. The scholarship has an approximate value of £140, and is tenable for one year. Candidates must be British subjects, less than twenty-seven years of age on July 1, and preference will be given to those associated with the County Borough of Sunderland. Awards of the following scholarships will also be made this year—Duddell Scholarship, annual value £150 for three years, age limit, nineteen years; Ferranti Scholarship, annual value £250 for two years, age limit, twenty-six years; Silvanus Thompson Scholarship, annual value £100 and tuition fees, age limit, twenty-two years, for two years, for works employees. Applications (specifically mentioning the name of the scholarship) for particulars of any of these scholarships should be addressed to the Secretary of the Institution, Savoy Place, London, W C 2.



## Calendar of Geographical Exploration

May 22, 1739 —The Ainu Race

Capt Spangberg left the harbour of Bolshaya Reka in Kamchatka on a journey to Japan. The Russian Government had sent him out in 1738 on one of the numerous northern expeditions organised about that time. Drift ice prevented anything but a survey of the Kurile Islands to lat  $46^{\circ}$  N in the first year. But after wintering in the above harbour, Spangberg with a companion vessel commanded by Walton, though separated by fog and storm, reached Japan. On the return journey Spangberg landed on an island north of Nippon in lat  $43^{\circ} 50'$ , where he saw the Ainu people, distinguished by their exceedingly abundant growth of hair. The Japanese and the Ainu everywhere received the Russians in a most friendly way. The Japanese archipelago, as surveyed by Spangberg and Walton, was so different from the maps then in use in St Petersburg that doubt was cast on their results and Spangberg was ordered to make a second voyage.

May 22, 1795 —Mungo Park on the Niger

Mungo Park, then twenty-four years old, left England for the first of his African voyages of exploration. He had previously sailed as a surgeon to Sumatra and had considerable botanical and zoological interests. On Dec 2, 1795, he set out on his journey to the interior, taking with him only a native and a slave boy. After a terrible journey, during which he was imprisoned and later suffered tortures from thirst and hunger, he succeeded in reaching Segu on the Niger and determining the eastward course of that river. On July 29, 1796, after following the Niger for eighty miles from Segu, he decided to leave the river and set out for the coast, a journey of 1900 miles, which he successfully accomplished, reaching the Gambia in May 1797. In January 1805, Park left England for the Gambia for the second time. He took with him a party of about forty Europeans, but most of them died before the Niger was sighted on Aug 18. Park sent back his journal, and set out to sail down the river on Nov 19. He and his party passed Timbuktu and reached the Bussa rapids in lat  $10^{\circ} 45' N$ , where the canoe stuck fast on a rock and the natives at the same time attacked the party from the shore, all were drowned. Though Park did not succeed in solving all the problems of the course of the Niger, he eliminated many of them.

May 23, 1875 —Inland Exploration of Australia

E. Giles began his journey from Port Augusta at the head of Spencer Gulf to Perth on the west coast of Australia, passing Lake Moore on his way. From Perth he went northwards to the upper Ashburton River and crossed Gibson's Desert from west to east. Giles had previously, in 1872, examined the upper course of the Finke River, penetrating into Gibson's Desert from the east. He was, however, compelled by adverse conditions to return without crossing it.

May 26, 1616 —William Baffin

Bylot and Baffin sailed on the most memorable of Baffin's many voyages. Baffin's Bay was discovered and explored, together with the magnificent series of straits which radiate from it, which were named Lancaster, Smith, and Jones Sounds, in honour of the patrons of his voyage. For 236 years, Baffin's farthest north, about  $77^{\circ} 45'$ , remained unsurpassed in that sea. Baffin is first mentioned as chief pilot on a voyage to search for the north-west passage in 1612. In 1615 he carefully examined Hudson Strait, the accuracy of

his soundings and observations being confirmed by Sir Edward Parry two centuries later (1821). In 1617-1619, Baffin surveyed parts of the Red Sea and the Persian Gulf, where he was killed in 1620. Baffin made numerous scientific, especially magnetic, observations. He was the first to determine longitude at sea by lunar observations.

May 27, 1926 —The Shaksgam Valley

Major Kenneth Mason reached Leh, whence he penetrated to the Shaksgam Valley, not visited by a European since Younghusband discovered it in 1889. Mason also explored the Aghil ranges and discovered the main features of the watershed between the Indian Ocean and Central Asia. His surveys altered the conception of the region and proved that the country beyond the Shaksgam River consists of a series of parallel ranges similar to those found on its Indian side.

May 28, 1789 —The Solomon Islands

Lieut. Shortland reached England after a voyage which added much to the map of Oceania. Shortland had accompanied the expedition of Capt Arthur Philip, sent out to found a penal settlement in Australia. On the return journey Shortland discovered "Sir C. Middleton's" Island, and on July 31 sighted San Cristobal, the most southerly of the Solomon group. He did not realise that the islands were separate, but thought that they were all one large island, to which he gave the name of New Georgia. He touched at Simba, and then went through the strait between Choiseul and Bougainville islands, sighting many small islands to the west, to which he gave the name of Treasury Islands. Alu, the largest of this group, is now generally known as Shortland.

## Societies and Academies

## LONDON

Physical Society, March 4 —L. G. Carpenter and T. F. Harle. A vacuum calorimeter for high temperatures. A form of the platinum-thermometer type of vacuum calorimeter has been developed which is suitable for the determination of true specific heats at high temperatures, since it is constructed without any organic insulating materials. The design is novel, in that the heat is transferred from the platinum coil to the calorimeter by radiation. —Hugh Carmichael. A new tilted electrometer. A new instrument on the principle of the Wilson tilted gold-leaf electrometer. It has a quartz fibre 'leaf' which moves in hydrogen to reduce sluggishness. Typical sensitivities of 3 mm. and 30 mm. fibre movement per volt (linear for 2 mm. and 1 mm. respectively) have been obtained, and a reliable eye-piece scale sensitivity of 1000 divisions per volt is within the range of the instrument. —N. W. McLachlan. The symmetrical modes of vibration of truncated conical shells with applications to loud-speaker diaphragms. With paper, glass, and aluminium shells, the modes crowd together as compared with the segregation which occurs in the case of a disc. With thick glass or aluminium of comparatively low loss, the nodal frequencies are very clearly defined peaks. In the case of paper cones driven by coils of small mass, the peaks disappear and the nodal region is indicated by a broad rounded contour. The influence of thickness, apical angle, and the mass of the driving coil are treated.

Society of Public Analysts, April 6 —K. Culhane and S. W. F. Underhill. The estimation of hormones. A description is given of the estimation of insulin,

pituitary posterior lobe extract, and adrenaline The effects of variations in the sensitiveness of the different animals is reduced to a minimum by using fairly large groups of a uniform stock —G Middleton The chemical assay of thyroid gland For the determination of the iodine content of thyroid gland a method is recommended in which the material is ignited with sodium carbonate in a double crucible —F W Jackson and Osman Jones The water-protein ratio of lean meat, and its bearing upon the analysis of sausages Data are given for the ratios of water to protein in samples of meat representative of the average quality used by the manufacturers of high-grade sausages By the use of these ratios the proportion of meat in sausages may be determined with a close approximation to the amount actually present —Osman Jones Nitrite in cured meats Nitrite-cured meats may contain 960 parts nitrite per million when brine has been repeatedly used for curing The only function of the nitrate is to impart a red colour to the meat by reduction to nitrite It would be advantageous to replace nitrates in curing by a very small amount of nitrite —H C Lockwood Notes on the freezing point of milk An apparatus and method for the determination of the freezing point of milk are described

Optical Society, April 14 —F Twyman A photometric eyepiece for visual quantitative spectrum analysis A new type of eyepiece is described whereby a spectrum is split into halves, a selected line of one spectrum being brought vertically above a selected line of the other spectrum The intensity of the brighter line is then reduced by means of a neutral tint wedge until equality of the two intensities is obtained The eyepiece is used in an analysis of some cadmium-lead alloys, an accuracy of some 11 per cent of the content being obtained —T Smith and J Guild The CIE colorimetric standards and their use The new international standards, which define a standard observer, three standard illuminants, standard conditions of illuminating and viewing opaque specimens, a standard for evaluating the brightness factor of opaque specimens, and a standard trichromatic system for the expression of colour measurements, are stated and their origin explained In addition to the numerical tables which are appended to the resolutions setting up these standards, there are given a table specifying the trichromatic co-ordinates for the standard observer of all spectral colours at wave-length intervals of 1 mμ, tables to facilitate the calculation of the standard co-ordinates and the brightness factor of a material illuminated by any one of the three standard illuminants from spectrophotometric measurements on the material, and a table giving the co-ordinates of some stimuli of special importance on the N P L system, the standard system, and another system which occurs in the resolutions

## PARIS

Academy of Sciences, April 4 —E Goursat A partial differential equation —Paul Stroobant was elected *Correspondant* for the Section of Astronomy —E Batelle The probability of an election by an absolute majority in one or two ballots —Georges Giraud Certain cases of discontinuous data relating to the problems of values at the boundary —Lars Ahlfors The inverse functions of meromorphic functions —N Théodoresco The problem of Cauchy for the equations of Dirac —Charles Florisson Acoustic testing by echoes at the edge of noisy aeroplanes Description of an acoustic altimeter capable of giving the height of the aeroplane above the ground to within about five metres —L Brillouin and M

Lévy A reaction wiring independent of the frequency —G Rassat The Curie point of ferro-cerium Ferro-cerium with about 27 per cent of iron loses the property of being attracted by a magnet at about 40° C Some possible applications of this property are suggested —S Rosenblum and Mile. C Chamié The fine structure of the α-radiation of radiothorium —Mile Suzanne Veil The individual diffusion of the Liesegang reagents in gelatine A study of the diffusion of potassium bichromate and of silver nitrate, taken separately, in gelatine The action of the electric field on each is also described —H Hering The heterogeneous equilibria in the system cadmium chloride, potassium chloride, and water —J Zawadzki and S Bretsznajder The influence of certain agents on the velocity of formation and of the thermal decomposition of some carbonates —Pierre Dubois A recording apparatus for potentiometric determinations A description, with diagrams, of an apparatus which has been in use for more than a year for the automatic titration of manganese —Ed Chauvenet and P Avard The determination of barium sulphate in iron ores By heating the mineral to 450° C in a stream of carbon tetrachloride vapour, iron and aluminium are removed as volatile chlorides, whilst barium chloride (with other non-volatile chlorides) are left in the boat, and can be separated without difficulty —E Carrière and Raymond Lautie The determination of molybdenum by potassium permanganate The conditions are described under which molybdenum salts can be reduced by zinc and dilute sulphuric acid to Mo<sub>2</sub>O<sub>3</sub> —A Kirrmann and R Rambaud A new example of the allyl transposition The type of transposition is that indicated by the formulæ  $\text{CH}_2 \text{ CH CHR} \text{X} \rightarrow \text{CH}_2 \text{X CH CHR}$  The case described is the production of  $\text{CH}_2\text{Br CH CH (CO}_2\text{C}_2\text{H}_5)$  by the action of  $\text{PBr}_3$  on  $\text{CH}_2 \text{ CH CH (OH) CO}_2\text{C}_2\text{H}_5$  —Nicolas Drisch Researches on the acetylenic arylcarbinols, *p*-bromophenylethynyl-diphenylcarbinol and its derivatives, its transformation into the ethylene ketone —J P Arend The mode of formation of the oolitic deposits in Lorraine and Luxembourg —Picon The amount of organic carbon in different waters A micro-method based on sulphochromic oxidation —Emm de Martonne An attempt at the morphological synthesis of the Carpathians —Ad. Davy de Virville The distribution of lichens in the island of Cézembre —Roger Heim The formation of the spores in Podaxon —Gard Autumn frosts, oxidising diastases, and death of plants in full growth The physical effects of exposure to frost are loss of turgescence, exudation of the water of the protoplasmic hydrogel and of the vacuome From the chemical point of view, there is an increase in the peroxidases and the tyrosinases and a greater oxidation velocity —Charles Perez Some differential characters of the sexes in *Eupagurus bernhardus* —Serge Yourievitch The value of the ocular movements in æsthetic emotion —H Bordier Experiments on the biological effects of d'Arsonvalisation with short waves From experiments on fish it is concluded that these high frequency waves do not act simply by their calorific effects, but have a selective action on living tissues —Rene Chaux Researches on the influence of the Δ<sub>2</sub>-cyclopentenyl radical in the series of barbituric hyponotics A pharmacodynamical study of Δ<sub>2</sub>-cyclopentenylallyl-barbituric acid A series of barbituric acid derivatives containing the Δ<sub>2</sub>-cyclopentenyl group has been prepared, and the hypnotic action studied on the usual animals (fish, mice, rabbits, dogs) compared with veronal as a standard Δ<sub>2</sub>-cyclopentenylallyl-barbituric acid possesses hypnotic power nearly four times that of veronal The security coefficient

(ratio of maximum dose tolerated to efficient dose) is 4, as against 2.5 for veronal.—Paul Mathias The development of the egg of a phyllopod crustacean, *Artemia salina*.—Maurice Lecamp The experimental production of supernumerary members in *Alytes obstetricans*.—Georges Lakhovsky Concerning the bactericidal power of metallic silver Reply to some criticisms by Ph. Lasseur, M. Pierret, A. Dupaix, and C. Maguotot.—G. Mouriquand, A. Leulier, and Mlle L. Weill Experimental hypotrophic rickets.—P. Remlinger and J. Bailly A new enzootic disease of the rabbit suppurating otitis of the middle ear

## GENEVA

Society of Physics and Natural History, Feb. 18.—Fernand Chodat and Jean Landis Studies on the nutrition of the yeasts The authors present a study of the nutrition of the yeast fungi, capable of transforming under economic conditions inorganic nitrogen into peptide nitrogen *Endomyces anomalus*, which fulfils these requirements in a satisfactory manner, is studied from the points of view of its growth and autolysis.—Léon W. Collett and Ed. Parejas Results of the geological expedition of Harvard University in the Canadian Rockies (Jasper National Park), 1929 (6) Geological section along the Rockies, the Athabasca length The section surveyed by the authors extends over a distance of 50 km from the eastern edge of the Rockies to the river Miette, an affluent of the Athabasca It comprises seven distinct strata

March 3.—A. Borloz The pickling of copper-silver alloys in dilute sulphuric acid Experience in the cleaning of these 82.5 per cent alloys shows that the operation is more successful when copper sulphate is added In seeking for a theoretical explanation of this action, the author thinks that the copper cation acts as a surface catalyst, experiment having proved that electro-osmosis cannot be the cause.—Leon W. Collett and Ed. Parejas Results of the geological expedition of Harvard University in the Canadian Rockies (Jasper National Park), 1929 (7) The geology of Mount Edith Cavell The authors describe in detail some phenomena of detachment which are produced at Mount Edith Cavell and in the Tonquin Valley between an enormous mass of Cambrian quartzites and Pre-Cambrian clay schists.—(8) The broken strata of Moose Pass Are the overlappings of Moose Pass and Pyramid equivalent? This is the problem of tectonics set by the authors

March 17.—Th. Posternak The configuration of quercite By controlled oxidation with alkaline permanganate, the author has obtained a substance identical with Kihani's metasaccharonic acid From this a configuration is deduced which completely explains all its properties.—W. H. Schopfer The accessory growth factor of the micro-organism contained in the wheat germ its action on the sexuality of the *Phycomyces* The author's experiments make clear the existence in the wheat germ of a growth and sexuality factor the vitamin value of which is certain.—J. and L. Deshusses An anguillulosis of *hortensia* (*Hydrangea hortensis*) The authors have studied the ravages caused by *Tylenchus dipsaci*, more especially in certain varieties of *hortensia*, amongst others *Maréchal Foch* and *Niedersachsen* The *Goliath* and *De Vibraye* varieties are less attacked The authors make suggestions for fighting this parasite.

## PRAGUE

Czech Academy of Sciences and Arts, Oct. 16.—Boh. Němec Mixoploidy in *Allium caeruleum* Pal.—V. Posejpal Fourth contribution to the study of universal ether A formula for the intensities of the

K-absorption edge is deduced on the assumption that the cross-section of a photon has the same area as that of an ether particle.—B. Nováková The determination of differences of wave-lengths in spectra of the central region and limb of the sun measured by spectrocomparator and microphotometer.—F. Valentin A study in the series of alcoholic sugars Alcoholic sugars were converted by means of triphenylchloromethane into triphenyl-methylethers, and interesting regularities were found in the number of triphenylmethyl groups entering a molecule

Nov. 13.—J. H. Křepelka and B. Rejha The anhydride and hydrates of manganese sulphate Six forms of manganous sulphate were found, namely, anhydrous, simple, and bimeric monohydrate, tetra-, penta-, hepta-hydrate, other forms mentioned in literature, such as the hemi-, di-, tri-hydrate, second form of tetra-hydrate, and hexahydrate, do not appear to exist The melting points and ranges of existence are given.—O. Pankraz On the divergence of the Dirichlet integral

Dec. 11.—V. Posejpal Fifth contribution to the study of the universal ether From the conception of ether drift and on the assumption that the volume of ether carried away by molecules of water vapour equals that of water molecules calculated from viscosity, the author derives from the refractivity of water, vapour-radius  $\alpha$ , these denote the sphere of ether inside water molecules, which is impenetrable for photons,  $\alpha$  being given by  $\alpha + \beta\lambda$ .—F. Ulrich and J. Sandholzer Radioactivity of wells in the Riesengebirge in Bohemia.—M. Mikan (1) An example of Cremona correspondence in penta-dimensional space (2) Plane presentation of penta-dimensional forms.—J. Chloupek and V. Daneš Solubilities and activity coefficients of silver sulphate in certain salt solutions Exact solubility determinations were made in water and aqueous solutions of  $K_2SO_4$ ,  $(NH_4)_2SO_4$ ,  $KNO_3$  from 0.08 to 2N at 25° C, hence activity coefficients were calculated.—V. Prelog, G. Držić, and V. Hanousek On the bis- $\beta$ -halogenethylamines These compounds were obtained from bis- $\beta$ -hydroxyethyl-amines by means of halogen acids, they yield with potassium cyanide 2-imino-3- $\beta$ -halogenethyl-oxazolidines, and with potassium thiocyanate the free bases 2-imino-3- $\beta$ -halogenethylthiazolidines

## Forthcoming Events

## FRIDAY, MAY 20

ROYAL SOCIETY OF MEDICINE (Physical Medicine Section), at 5.30.—Annual General Meeting  
ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynaecology Section), at 8.15.—Annual General Meeting  
ROYAL SOCIETY OF MEDICINE (Radiology Section), at 8.30.—Annual General Meeting  
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. H. E. Armstrong Faraday at the Sign of the Hexagon Coal Colour and Constitution  
INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Sedbury, Monmouthshire)—Summer Meeting (continued on May 21 to 23)

## SATURDAY, MAY 21

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.—Annual General Meeting  
GERMAN CONGRESS FOR PSYCHICAL HYGIENE (at Bonn)

## MONDAY, MAY 23

VOLUNTARY EUGENIC STERILISATION (Conference at Caxton Hall, Westminster), 10.30 a.m. to 12.30.—Medical and Legal Aspects of Sterilisation, Sterilisation in Other Countries.—2.30 to 4.30.—Social and Moral Aspects of Sterilisation, Practical Proposals.—8.30.—Informal Discussion

- MIDDLESEX HOSPITAL MEDICAL SCHOOL, at 5—Prof Samson Wright Certain Aspects of the Reflex Control of the Circulation (Succeeding Lectures on May 26 and 30, June 2, 6, and 9)
- ROYAL SOCIETY OF ARTS, at 5 15—Sir Ernest Graham Little Dermatology as an Outpost of Medicine (Malcolm Morris Memorial Lecture)
- IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5 30—Prof F Silvestri The Biological Control of Insects and Weed Pests (1) (Succeeding Lectures on May 25 and 27)
- UNIVERSITY COLLEGE, at 5 30—Prof A. M. Tallgren Central Asiatic and Siberian Rock-Pictures (1) (Succeeding Lecture on May 25)
- IRON AND STEEL INSTITUTE (Additional Meeting) (jointly with Cleveland Institution of Engineers) (at Cleveland Technical Institute), at 7 30—Presentation of Papers
- ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8—Annual General Meeting

## TUESDAY, MAY 24

- ROYAL SCHOOL OF MINES (in Geological Lecture Theatre), at 12 noon—Dr H. Shaw Field Practice with the Torsion Balance (1) (Succeeding Lectures on May 27 and 31)
- IRON AND STEEL INSTITUTE (Additional Meeting) (jointly with Sheffield Metallurgical Association) (in Mappin Hall, Sheffield University), at 2 45—Presentation of Papers
- ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5—Annual General Meeting
- ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section), at 5—Discussion on Some Problems concerning the Prevention and Treatment of Acute Rheumatic Infection
- ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30—Rev T. Cullen Young Tribal Intermixture in Northern Nyasaland (Lecture)

## WEDNESDAY, MAY 25

- BRITISH SCIENCE GUILD (Annual General Meeting) (at Royal Society of Arts), at 4—At 5—Prof S. Chapman Polar Lights (Lecture)
- SCHOOL OF ORIENTAL STUDIES, at 5 30—Dr M. de Z. Wickremasinghe The Home of Pali, the Sacred Language of the Southern Buddhists (Lecture)
- INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6—Prof E. V. Appleton Our Present Knowledge of the Ionised Regions of the Upper Atmosphere (Lecture)
- BRITISH INSTITUTE OF PHILOSOPHY (at University College), at 8 30—Sir Herbert Samuel Philosophy and the Ordinary Man (Presidential Address)

## THURSDAY, MAY 26

- ROYAL SOCIETY OF MEDICINE (Urology Section), at 8 30—Annual General Meeting
- ROYAL AERONAUTICAL SOCIETY (in Science Museum, Aeronautical Section), at 9 15—H. E. Wimperis New Methods of Research in Aeronautics (Wilbur Wright Memorial Lecture)

## FRIDAY, MAY 27

- LONDON SCHOOL OF ECONOMICS, at 5—Prof L. Hogben The Biological Premises of Historical Interpretation (Lecture)
- ROYAL ANTHROPOLOGICAL INSTITUTE (Human Biology Research Committee), at 5 30—Discussion on the Standardisation of Anthropometric Method
- BIRKBECK COLLEGE, at 6—Dr H. J. W. Hetherington Theory and Practice (Haldane Memorial Lecture)
- ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8—Annual General Meeting
- ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Sir Walter Morley Fletcher New Conceptions of Medical Research

## SATURDAY, MAY 28

- NORMAN LOCKYER OBSERVATORY (Salcombe Regis, Sidmouth), at 3 30—Opening by Sir Frank Dyson of the 'Mond' Photographic Equatorial and Dome Other speakers: Sir Richard Gregory, Bart, Dr R. L. Mond, and others
- ROYAL SOCIETY OF MEDICINE (Physical Medicine Section)—Annual Summer Meeting (at Alton)

## Official Publications Received

## BRITISH

- Canada Department of Mines Mines Branch Investigations of Fuels and Fuel Testing (Testing and Research Laboratories) 1929 (No 721) Pp 131+8 plates (Ottawa F. A. Acland)
- Ceylon Journal of Science Section A Botany Annals of the Royal Botanic Gardens, Peradeniya Edited by N. D. Simpson Vol 11, Part 4, February 20th Pp 307-359+plates 45 52 3 rupees Section B Zoology and Geology Spolia Zeylanica Edited by Dr Joseph Pearson Vol 16, Part 3, March 18th Pp 229 356+plates 43 66 3 rupees (Colombo Colombo Museum, London Dulau and Co., Ltd.)
- Memoirs of the Geological Survey of India Vol 61 The Geology and Coal Resources of the Raniganj Coalfield By E. R. Gee Pp vi+343+vi+20 plates (Calcutta Government of India Central Publication Branch) 13 6 rupees, 22s
- Borough of Durban Durban Museum Annual Report for Municipal Year 1930-31 Pp 7+4 plates (Durban)
- London School of Hygiene and Tropical Medicine Memoir Series No 5 A Helminthological Survey of Southern Rhodesia By William K. Blackie Pp viii+91+7 plates (London London School of Hygiene and Tropical Medicine) Paper, 8s., cloth, 10s. 6d
- The Board of Greenkeeping Research Report for 1931 Pp 26 (Bingley St Ives Research Station)
- Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1931, presented to the Annual Meeting, February 8th, 1932 Pp 44+8+2 plates (York Yorkshire Museum)
- Transactions of the Royal Society of Edinburgh Vol 57, Part 1, No 6 The Primitive Conducting Mechanisms of the Vertebrate Heart—An Introduction to the Study of their Appearance and Development in *Lepidodendron paradoxo* By Tudor Jones Pp 225 240+4 plates 3s. 6d
- Vol 57, Part 1, No 7 Differentiation in the Sills of Northern Trotsenish (Slye) By Dr Frederick Walker Pp 241-257 2s. (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd.)
- Northern Coke Research Committee Annual Report, No 3, 1931 Pp 17 (Newcastle on Tyne Armstrong College)
- Transactions of the Institute of Marine Engineers, Incorporated Session 1932 Vol 44, No 3, April Pp 107-166+xxiv (London)
- Air Ministry Aeronautical Research Committee Reports and Memoranda No 1429 (T 3111) Flow of Compressible Fluid in the Neighbourhood of the Throat of a Constriction in a Circular Wind Channel By S. G. Hooker Pp 9+6 plates (London H. M. Stationery Office) 9d net
- Transactions of the Faculty of Actuaries Vol 14, Part 1, No 126 William Morgan, F.R.S., 1750-1833 A Lecture by W. Palm Elderton Pp 20 (London Charles and Edwin Layton) 1s 3d net

## FOREIGN

- Cornell University Agricultural Experiment Station Bulletin 529 The Social and Economic Areas of Yates County, New York By Harold F. Dorn Pp 52 Bulletin 535 The Control of Bottom Rot of Lettuce By G. R. Townsend and A. G. Newhall Pp 11 Bulletin 536 Soil-Acidity Studies with Potatoes, Cauliflower and other Vegetables on Long Island By P. H. Wessels Pp 42 (Ithaca, N.Y.)
- U.S. Department of Commerce Bureau of Standards Bureau of Standards Journal of Research Vol 8, No 3, March, Research Papers Nos 416 426 Pp 321 444 (Washington, D.C. Government Printing Office) 40 cents
- Field Museum of Natural History Geological Series, Vol 6, No 2 Upper Canadian (Beekmantown) Drift Fossils from Labrador By Sharul Hurar Roy Results of the Rawson Macmillan Subarctic Expedition 1927-28 (Publication 307) Pp 29 59+2 plates (Chicago) 25 cents
- Meddelande från Lunds Astronomiska Observatorium Ser. 2, Nr 64 Researches into the Theory of Regression By Walter Andersson Pp 198+8 plates (Lund) 14 kr
- Scientific Papers of the Institute of Physical and Chemical Research Nos 367 368 Note on the Hyperfine Structure of Mercury, by Kiyoshi Murakawa, La. Kauzo de la Influencia de Aldonita; Substancia al la Malmoliga Rapideco de Gipsocemento, I, de Sigeru Yamane Pp 97 108 (Tōkyō Iwanami Shoten) 35 sen
- Bulletin of the American Museum of Natural History Vol 63, Article 3 A List of the Rhopalocera of Barro Colorado Island, Canal Zone, Panama By E. Irving Huntington Pp 191 230 (New York City)
- Societas Scientiarum Fennica Commentationes Humanarum Litterarum, III, 8 Marriage Conditions in a Palestinian Village By Hilma Granqvist Pp vi+209 (Helsingfors Akademische Buchhandlung, Leipzig Otto Harrassowitz) 75 Fmk
- The Carnegie Foundation for the Advancement of Teaching Review of Legal Education in the United States and Canada for the Year 1931 By Alfred Z. Reed Pp iii+51 (New York City) Free
- U.S. Department of Agriculture Technical Bulletin No 281 Experiments with Insecticides for Codling Moth Control By E. J. Newcomer and M. A. Yothers Pp 29+4 plates (Washington, D.C. Government Printing Office) 15 cents
- The Science Reports of the Tohoku Imperial University, Sendai, Japan Fourth Series (Biology), Vol 7, No 1, March Pp 156 (Tokyo and Sendai Maruzen Co., Ltd.)

## CATALOGUES

- Catalogue de livres anciens et modernes rares ou curieux relatifs à l'Orient (No 20) Pp 251 304 (Paris Libr. Adrien Maïsonneuve)
- Vac Cittert double Monochromators with Optical Systems of Glass or Quartz (Mono 32) Pp 4 Short Beam Analytical Balance in Brass Case (Metan 31) Pp 2 Philips Fuses (Phi 32) Pp 2 (Delft P. J. Kipp and Zonen)
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SATURDAY, MAY 28, 1932

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## University Science Teaching

CONSIDERABLE attention has recently been devoted in the columns of NATURE and elsewhere to emphasising the importance to civilisation of the application of the type of thinking used in scientific research to the present difficult and widespread political, economic, and social problems. By an extensive application of the natural knowledge contained in the sciences of mathematics, physics, and chemistry, much progress has been made in satisfactorily feeding, clothing, cleansing, and housing humanity. Successful civilisation, however, involves much more than the satisfying of the most elementary bodily needs. Until the biological and mental sciences are much more advanced, science cannot supply the facts of these other needs.

As a result of this one-sided application of scientific knowledge, present civilisation is in danger of collapse. The recent official surrender of party politics in Britain, involving as it does much individual loss of personal advantages, may be interpreted as evidence that the politicians themselves have less faith than formerly in the power of their methods to deal with political problems. Since the application of the scientific spirit is the only seriously suggested method which has not been tried, it is worth while considering what practical steps should first be taken. These are generally believed to be certain changes in the nature and extent of science teaching, where the word science is used in its widest sense to cover both scientific knowledge about organic and inorganic objects and also scientific method, that is, the type of thinking by which the knowledge was established. It is assumed that the products of such education will then naturally use the type of thinking used in establishing scientific knowledge.

The fundamental difficulty lies in the striking fact that amongst research workers, who by the soundness of their work clearly prove that they are capable of applying, and in fact regularly do apply, scientific thinking in the laboratory, some do and some do not spontaneously apply the same type of thinking to problems outside the laboratory. This statement needs careful consideration, for it is almost impossible to give here supporting evidence. If, however, observation be confined to private conversation between intimate friends, it will be apparent that the regular and spontaneous application of scientific thought in the laboratory may or may not be accompanied by a spontaneous application of the same type of thinking

to affairs outside the laboratory. Undoubtedly, some research workers can and do detach and leave behind in the laboratory both the scientific way of thinking and the laboratory dust-coat, alike with equal ease and naturalness. If these men who regularly apply scientific method to one subject do not spontaneously apply it to other subjects, how can one reasonably expect, for example, the politician, who may well have had no scientific training whatever, to apply scientific thinking in dealing with political problems?

We would emphasise here that no known method could, on the basis of experimental evidence, be guaranteed to overcome this difficulty. Even intimate familiarity with a science does not compel the use of scientific thinking in that science or in other topics, but it must be remembered that no serious and widespread attempt has been made to teach scientific method. Evidence of such teaching may be sought in vain in the widely used textbooks of any of the sciences or in the examination papers of the universities. Since the present type of science teaching does not produce a scientific habit of mind, the only untried method which suggests itself as a possible means to such an end is the teaching of scientific method in addition to the teaching of the sciences. Although we would again emphasise that there is no adequate evidence to show that such teaching would produce the desired result, it must be realised that until the method has been actually tried such evidence could not exist. Since we believe that the method should be tried, we will tentatively offer various considerations as to the best means.

We must be quite clear as to what is proposed to be taught. Scientific method has nothing to do with the origin of new ideas spontaneously arising in the brain of an individual by a process known to no man. It is concerned solely with the way those ideas have to be developed to *establish* a new piece of knowledge. Scientific method can be reduced to comparatively few principles, the application and misapplication of which can be well illustrated even in the most elementary science teaching. The principles would be best absorbed by constant reference to them in the ordinary lecture and laboratory instruction rather than by an attempt to teach them in a separate course. Where this plan of constantly associating principles with facts is adopted throughout the school and university course, the actual time devoted to instruction in scientific method would not amount at most to more than a few minutes in each hour of teaching.

A science such as physics, combining as it does both mathematics and experiment, is especially well adapted to the teaching of scientific method, and great care would have to be taken that the elementary courses in physics and in chemistry were carefully planned so that students who later specialised in biological sciences would have obtained a good idea of the principles of scientific method from their elementary course in physics and chemistry, where the phenomena are of comparative simplicity. Instruction in scientific method would of course be continued in combination with the advanced biological training, but since biological science cannot deal with standard normal objects, the statistical complications make it less suitable as a medium for a first initiation into scientific method.

Although this teaching of scientific method should ultimately be carried out in both school and university, it will naturally have to start in the universities where science masters receive their more specialised training. Here will arise the difficulty of a dearth of teachers. Since the standard textbooks of all the sciences give only the facts and principles of the sciences, and pay no attention to the kind of thinking by which the facts are established, the new science teaching will have to be created separately by each of its supporters.

University teachers are, however, of three types. First there is the research worker, for whom a university is essentially the only place where research work may be carried out without any thought of its industrial application, and where the teaching duties must be merely tolerated. For the second type, a university differs essentially from a school only in that the students are older pupils who have to be spoon-fed for fewer teaching hours with fewer but more difficult subjects than at school. This type usually does no research whatever. In the lecture room, his courses admirably cover the field on which the student will later be examined. In the laboratory, no sooner is a student in difficulty than the demonstrator is by his side, ensuring no 'waste' of the student's time, by at once pointing out the errors. This type would, by his professor, be described as a good teacher—the adjective being used, dare we venture to suggest, as a reward for the *smooth* running of teaching laboratories. From neither of these types would one naturally expect the new teaching. The most likely source is the third type, who at heart believes and practises that research and teaching are equally prime functions of a university. As there would be a danger of this type being sadly



overworked, we will consider how far *extensive* lecture and laboratory courses are nowadays necessary in teaching science subjects in universities

Apart from tradition, only three reasons for lecture courses need be considered. First, since science deals with Nature rather than with books, the actual objects and phenomena of a science must, wherever possible, be seen or experienced by the student. This justifies the lecture illustrated by experimental and other means. Secondly, lectures which, although not illustrated by experiment, deal with advances so recent that they do not appear in the textbooks, are necessarily a part of all honours degree courses. The third reason often given for extensive tuition in universities needs more careful examination. It is frequently stated in discussions that in the provincial universities many of the students cannot absorb knowledge from even the best written textbooks. If it can be established that some students worthy of university education cannot be *trained* in the upper forms of schools and in the universities to assimilate ideas and knowledge from the symbols of a printed page, then surely gramophone records, sound-films, and 'readers' who would read aloud from good textbooks should all be used for this type of student. Their possible existence in universities is no justification for extensive spoon-feeding courses of lectures.

As to laboratory instruction, all science students, no matter how brilliant, must spend time in the laboratory in familiarising themselves with the main objects and phenomena of their particular science and in acquiring its manipulative technique. Such essential laboratory courses would serve admirably for illustrating practical application of scientific method. It is highly controversial whether the more extensive laboratory courses designed to help weak students to acquire knowledge are in reality justifiable, and it is very doubtful if they should be regarded as essential for all students. They offer little scope for developing the student's powers of imagination, they leave him little time for independent reading, they hinder the combined study of two sciences, such as, say, geology and physics, they prevent the combined study of three sciences, such as physiology, physics, and chemistry, and finally, they absorb time of demonstrators which should be devoted to research. Whilst spoon-feeding of some ordinary degree students may by some be regarded as desirable, there can surely be no justification for the spoon-feeding of honours degree students. The wisdom

of the policy of helping normal students to get honours degrees so that they will receive higher salaries in schools adopting the Burnham Scale is extremely doubtful, since it favours the present highly specialised school science teaching with its shocking neglect of biological science, a course which is itself of doubtful value even for the one student out of every thousand who may ultimately become a specialist research worker.

As we see it, then, present needs would best be served if extensive spoon-feeding lecture and laboratory courses were abolished in universities, and if into all science teaching instruction in scientific method were incorporated. When good means of accomplishing this have been developed by actual trial, all the textbooks intended for undergraduates should be rewritten so as to include always some discussion of the means by which the facts and principles of the knowledge are established. This type of science teaching should then spread to the schools, where, as a means of discouraging early specialisation, higher salaries should not necessarily be paid to masters with honours degrees. Extensive science teaching of even the best present type—that which includes biological science—can always be justified on the ground that it teaches the nature of the environment in which human life must be spent. It is too much to hope that the new science teaching would in addition tend to induce a scientific habit of mind, but if it could induce, for example, an appreciation of the differences between fact and opinion, it would be well worth while.

W H G

### Form and Size

*Problems of Relative Growth* By Julian S Huxley  
Pp xix + 276 (London Methuen and Co, Ltd,  
1932) 12s 6d net

**D**URING the greater part of his life, man changes but little in form. In this important character he differs greatly from the majority of living organisms. By reference to ourselves, the concept of the form of an organism appears well defined, but this is to a large extent the result of our own constancy. In most organisms, our task is not that of describing a single well-defined structure, but the description of a sequence of continuously changing structures.

The study of these structural changes is of great importance. Any empirical rules which can be found to bring order into the embarrassing array of facts and observations are most valuable, for it is only with the aid of such rules that we can perceive the nature of the problems which require solution.

Huxley has succeeded admirably in bringing about such a co-ordination of data in his latest book. He has shown that certain comparatively simple relations between the sizes of various parts of the organism hold over a very wide range of cases and throw light on many obscure facts.

When an organism increases in size, its organs and limbs do not necessarily—nor, indeed, usually—increase at the same rate as the whole organism. Some structures develop at a much faster rate than the organism as a whole. Such 'heterogonic' growth leads to progressive change in the form of the organism, so that in large individuals the relative proportions of their parts may differ greatly from those of small ones. Huxley has shown that such facts may be expressed quantitatively by an empirical formula. If  $y$  represents the magnitude of an organ and  $x$  represents that of the rest of the organism, then the relation,  $y = bx^k$ , expresses the magnitude of the organ for any given size of the organism,  $b$  and  $k$  are constants,  $k$  representing the relative rate of increase of  $y$  with respect to  $x$ . If  $k = 1$ ,  $x$  and  $y$  increase together at the same rate, and the form of the animal remains unchanged as it increases in size, that is, growth is isogonic. But if  $k > 1$ , the organ increases more rapidly than the rest of the body, and the form of the organism undergoes continuous heterogonic change.

The formula is necessarily empirical. Of the causes of differential growth we have little knowledge, their investigation is the problem at issue. A variety of possible relations might, in fact, reduce approximately to this formula. But it is not the object of the formula to establish the correctness of a particular hypothesis as to the cause of differential growth, it merely expresses the observed facts with considerable accuracy in a simple way, so that many very significant features emerge which would not otherwise do so.

The formula clearly lends itself to graphic expression, and it is found, by plotting a large number of observations, that the value of  $k$  remains constant over a wide range of size. The large chela of the fiddler crab, *Uca pugnax*, increases in size about sixty per cent more rapidly than the rest of the body, so that though the chela is initially of normal proportions in the smallest individuals, it may approach seventy per cent of the weight of the rest of the body in the largest. Despite this gross change in form, the constant value of  $k$  shows that the relative growth rate of the chela has remained unchanged. The growth rates are thus a more constant feature of the organism than the morphological structure at any stage.

The substantiation of such an empirical relation necessitates its application in a very large number of instances, and the author has taken pains to establish it over a wide selection of organisms, ranging from plants to mammals.

It is important to realise that the relation compares the relative size of parts with increasing size of the organism. It makes no implication as to the actual rate of growth. Such increase in size is certainly brought about by growth—in which time governs the degree of multiplication undergone by the living substance. But Huxley points out that it is not necessarily the rate of growth which is regulated in accordance with the formula. The antlers of deer follow the heterogonic relation, but these are shed each year, so that their size in relation to body-weight cannot be the accumulated result of continuous growth at a rate different from that of the body. In fact, the relation is not the simple consequence of rate of growth at all, but expresses some natural limitation of the extent to which an organ can grow with respect to the size of the rest of the animal. The discontinuous growth of arthropods yields similar evidence. But the most convincing evidence that the relation concerns size limitation rather than growth rate comes from observations that regenerating organs grow at a highly accelerated pace until they reach the appropriate size corresponding to the formula, after which the rate drops to a value consonant with the normal. The evidence of transplantation of organs suggests that this limitation of size is controlled in part by mechanisms specific for each organ.

The conclusion that in Huxley's formula we are dealing with conditions of size limitation rather than rate of growth is very important, and illustrates how productive may be this method of approaching the problem.

The principle of heterogonic growth greatly simplifies a large number of problems concerning form. Polymorphism and dimorphism in insects can be shown in some cases to be the direct consequence of heterogonic increase in particular organs with increase in size. Nor is the principle limited to particular species, homologous organs tend to undergo heterogonic increase with increasing size among related species. The significance of this is far-reaching, and may well open to experimental attack the peculiar limitations in the evolution of organ-form associated with orthogenesis.

Heterogonic growth is not a localised condition in one particular organ. It is the result of a growth gradient which, while it may reach its maximal expression in a particular organ, in fact pervades the

whole organism. The form of the organism may, indeed, be interpreted by means of a system of such growth gradients. The expression of the size relations of organs in terms of heterogonic growth thus becomes a special application of the rules governing form which were first put forward by D'Arcy Thompson, to whom the author expresses his debt.

Of the origin and nature of the growth gradients we have at present little knowledge. But the influence of hormones on the relative growth of the parts of animals suggests that the control of size may in part be under such chemical influences.

Perhaps the outstanding conclusion of the whole book is the importance of size regulation independently of rate of growth. It is possibly a pity that the attempt to relate heterogonic size change and growth rate should be made at the beginning of the book rather than at the end. The heterogonic formula which the author has emphasised is an empirical one. It does not rest upon preconceived hypotheses as to the nature and rate of growth processes. For such an empirical relation no apology whatever is required, for its usefulness is fully demonstrated throughout the book. The importance of the relation of heterogonic size change to rate of growth is abundantly clear, but the book leads us up to this problem rather than employs it as the basis upon which the work has been executed. But this is a matter of opinion. In any event, it cannot obscure the essential fertility of the method for the presentation of problems in a form suitable for experimental solution.

The book is well and profusely illustrated. It is a book which every biological library should possess and every student of biology can read with profit.

C. F. A. PANTIN

### Modern Theoretical Physics

*Theoretical Physics* By Prof W Wilson Vol 1  
*Mechanics and Heat, Newton-Carnot* Pp x + 332 (London Methuen and Co, Ltd, 1931)  
21s net

THE difficulty of presenting to students an account of the theoretical side of physics which will be adequate without being so voluminous as to encroach unfairly on the time available for other aspects of the subject, is one which to-day must cause much anxious thought to university teachers. It is not merely a question of the increasing amount of material to be handled. The changes which have taken place in fundamental principles, the transitional character of some of

the hypotheses which have helped to support the structure in this period of change, and the tendency to abandon the physical model in favour of the mathematical equation as a basis for 'explanation', combine to make it an almost impossible task for the teacher to guide the studies of his pupils so wisely that nothing of importance for exhibiting the unity of physical theory shall be omitted and, at the same time, sufficient time shall be allowed for proper assimilation of principle and application even on the part of the brightest honours man.

In this embarrassing situation, every teacher and student should welcome the work of Prof Wilson, of which the first volume is before us. This volume is entirely classical in character, and its contents can be roughly grouped under three headings, mechanical, statistical, and thermodynamical. In view of the fact that no one can fully appreciate the changes wrought in physical theory by the quantum hypothesis without a real grasp of general dynamical methods, the author is to be commended for having devoted a considerable portion of the volume (nearly one-third) to an admirable account of dynamical theory embodying a well-chosen body of special applications, many of which will be required later for the purposes of atomic models, and leading to an exposition of Hamilton's equations and the principle of stationary action. There is a chapter on the general equations of wave propagation, and one on the analysis of stress and strain in elastic media, two further chapters on the dynamics of perfect and viscous fluids complete the part of the volume devoted to purely mechanical considerations.

The material chosen for this part has been wisely selected, and the method of treatment is careful, detailed, and free from the 'scrappiness' which characterises many expositions of this most important branch of physical science. The methods of statistical mechanics are outlined in a chapter which might well have been longer, in view of the highly abstract nature of the Gibbs ensemble, which would well merit a few more pages of explanation. Three chapters are devoted to the laws of thermodynamics and applications of them to homogeneous and heterogeneous systems, the Kelvin scale of temperature, latent heats, the phase rule, and dilute solutions. There is also a chapter on the kinetic theory of gases.

The one disappointing feature of the book is the failure to utilise vector and tensor methods in a more thorough fashion. To be sure, the author gives an exposition of vector and tensor analysis at the outset and promises a more complete

discussion in a later volume, but it seems to the reviewer that had a fuller account of these matters been provided here, much space would have been saved in this volume by the abandonment of clumsy Cartesian expressions in favour of the elegant and concise vector equations, not to mention the fact that the volume would have been imbued much more with the real spirit of the vector calculus. There is a danger that the reader may regard vector symbolism as merely a convenient 'shorthand' for Cartesian equations and expressions.

The author's use of clarendon type does not appear to be consistent. It is generally understood that such type is used only for vector quantities, whereas in this book it is at times employed to represent scalar quantities as well. However, in all other respects the work has been admirably done, both in the range of topics which have been dealt with and the completeness of the analytical methods employed. The book can be heartily recommended to student and teacher alike, and it is to be hoped that the two subsequent volumes, which are to deal with electromagnetism, optics, relativity, and quantum mechanics, will not be long delayed.

### Snow and Ice Crystals

*Snow Crystals* By W A Bentley and W J Humphreys Pp ix + 22 + 204 plates (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1931) 60s net

MR W A BENTLEY, whose death on Dec 23, 1931, at the age of sixty-six years we regret to record, was known for many years as a patient and skilful artist and photographer of snow and ice crystals, Mr W J Humphreys as a no less skilful physicist and meteorologist. Between them, they have produced a most unusual and very readable book. Incidentally, Mr Humphreys has also revealed himself on the last page of this publication as a poet of no small merit.

The publication of the book is due to the generosity of an anonymous donor to the American Meteorological Society. The book consists of 227 pages, of which all but twenty-two are reproductions of photographs taken during many years by Mr Bentley. More than two thousand photomicrographs are reproduced, the majority of which are of varieties of snowflakes. Other forms of snow crystal are, however, represented, together with examples of ice flowers, window-pane frost,

dew, rime, and other types of ice formation. These reproductions will appeal to any artist, but the diversity of form of the crystals is at first somewhat bewildering. This is due partly to the variety of shape of the crystals, but even more to the varied structure of the flakes due to the inclusions of air or water, variations in thickness, and surface water films resulting from slight melting. These differences in structure depend on the conditions in which the snowflakes were formed, and it should be possible, therefore, to gain some insight into the conditions associated with the formation of a definite type, when sufficient further data become available. Unfortunately, the places of origin and the paths pursued by the flakes falling at any instant at one spot may vary, and some information regarding the diversity of form amongst a number of flakes collected simultaneously would have been welcome.

Evidently it is not easy to deduce cause from effect in such a complicated subject, and it is apparently not possible to amplify Bentley's statement in the *Monthly Weather Review* of May 1901, regarding the relative abundance of crystals of simple and complex shapes in the opposite sectors of general snowstorms in the United States. The general rule is that the simpler kinds—columns, needles, and plates—are formed at greater altitudes and in lower temperatures, and are associated with relatively slow growth. They are thus most commonly found in high latitudes, and this accounts for the statement, no doubt true for the New England States, that perhaps three-fourths of all snow crystals belong to the 'tabular' type. Brief reference is made to the types of snow crystal which cause haloes.

In some respects, the most interesting of the photographs are those of window-pane frost, the forms of which are doubtless sometimes associated with the structure of the glass surface. Why, however, these should sometimes take the form of graceful plumes, why sometimes possess a granular structure, and why, at other times, form a 'fir-tree' or 'herring-bone' pattern, is extremely puzzling, and the explanation must be associated with the availability of moisture, the rate of formation, and possibly the form (vapour or liquid) in which the moisture is present.

More information regarding the very interesting ice flowers shown on p 221 would have been welcome. The photographs show round discs of ice which have formed in water. These later develop scallops on their circumference, which then grow more quickly in six favoured equidistant

places, and finally develop into a crystal form reminiscent of certain snowflakes. One of these photographs shows how crowding has impaired the symmetrical growth. Other examples of equal interest were illustrated in the *Monthly Weather Review* for November 1907.

It is hoped that the publication of this volume will stimulate interest in a study which is not only fascinating, but also requires little apparatus, though much patience and skill, for its prosecution.

### The Evolution of Culture

*The Evolution of Culture* By Julius Lippert  
Translated and edited by Prof. George Peter Murdock. Pp. xxxiii + 716. (London: George Allen and Unwin, Ltd., 1931.) 20s. net.

PROF. MURDOCK, of Yale University, has made an admirable translation of Lippert's "Kulturgeschichte der Menschheit in ihrem organischen Aufbau" (1886-87), which together with his other writings, gained for the author the reputation in Germany of being in the front rank of sociologists, though his work has scarcely had due recognition in other countries. At that time trustworthy data on the ethnography of backward peoples were very scanty and incomplete, so it is not surprising that occasionally his imagination led him beyond his facts and that he was inclined to read too much into them. Such faults are characteristic of most pioneers, but Lippert consciously strove to be inductive, as is shown by his use of the method of comparative ethnology. His approach was distinctly evolutionary, as was almost inevitable at that time, and he covered, so far as he could, the whole field of social anthropology with a due regard to balance and perspective. He did not, however, make the common mistake of confusing evolution with progress. Although Lippert says that "human ingenuity has striven in different places to achieve the goal set by the care for life with the elements there at hand" (p. 169), he does not ignore diffusion from a single centre in the case of the bow (p. 180) and claims it for the fire cult (p. 584) and for the origin of grape wine (p. 199), but in his time the conception of the diffusion of cultures had not achieved the importance which it has now attained.

Although, according to Lippert, social evolution finds expression in increasing foresight and socialisation, and although he regards economic factors as playing an important part in that evolution, he recognises that it is "characteristic of the evolution of mankind that on each stage it has

been stimulated and directed by a subjective element, its store of ideas. Undoubtedly man has gone astray on devious paths in his interpretation of objective reality on these devious paths of trial and error man has created, or rather acquired incidentally, a series of means adopted to bring about social integration and an extension of foresight" (p. 345).

The editor has wisely used his discretion in translation, his object was to do full justice to the meaning rather than to the wording of the original text, and thus we are indebted to him for a clearly expressed rendering of a very ponderous and involved argument. The original was devoid of references, but wherever possible the editor has recovered these and has added very numerous references to more recent literature which largely make up for the out-of-date information of the author. Lippert himself was strongest on the history and literature of classical antiquity and on the folklore and history of the Germanic and Slavic peoples, and he was fairly well acquainted with the then available ethnographic evidence. He is eminently suggestive, and students of sociology will find much that will throw light on problems in which they are interested.

A. C. HADDON

### Short Reviews

*Annual Reports on the Progress of Chemistry for 1931*. Issued by the Chemical Society. Vol. 28. Pp. 443. (London: Chemical Society, 1932.) 10s. 6d. net.

THE divisions of chemistry which receive annual treatment in the Chemical Society's report—general and physical chemistry (C. N. Hinshelwood), inorganic chemistry (H. Bassett), organic chemistry (aliphatic: E. H. Farmer, homocyclic: G. M. Bennett and J. W. Baker, heterocyclic: S. G. P. Plant), analytical chemistry (J. J. Fox and B. A. Ellis), and biochemistry (A. G. Pollard and J. Pryde)—are on this occasion joined by crystallography (J. D. Bernal and W. A. Wooster), colloid chemistry (W. T. Astbury, D. C. Henry, E. K. Rideal, and R. K. Schofield), and the structure of simple molecules (N. V. Sidgwick and E. J. Bowen). The sound policy of not attempting the impossible is continued, and the report therefore is to be regarded as a collection of short reviews on selected subjects rather than as a compressed record.

Among the subjects treated by Mr. Hinshelwood are effects attributed to the intensive drying of liquids, adsorption at surfaces, and chemical kinetics. Prof. Bassett refers cautiously to the announcement of the discovery of the missing alkali metal (No. 87), Dr. Farmer commences his section with a discussion of olefinic and polyolefinic additions, Prof. Bennett and Dr. Baker continue

the study of prototropy which was dealt with in the 1929 report, that of aromatic substitution from 1930, and that of the bile acids from 1928. Dr Plant's chapter refers to oxygen ring compounds, five-membered nitrogen ring compounds, and alkaloids. The report on analytical chemistry includes a discussion of the sensitiveness of precipitation reactions, and refers to the analytical use of arc and spark spectra.

Biochemistry was enriched during the period under review by important new knowledge concerning the fat-soluble vitamins. The report on crystallography covers the progress of two years, and is divided into crystal physics and crystal chemistry. The report on colloid chemistry is confined to three important topics: the structure of fibres (Dr Astbury), electrokinetic phenomena (Mr Henry), and the colloid chemistry of clays (Dr Schofield), that on the structure of simple molecules to the distances between the linked atoms, the force constants of the links, the mean restoring forces during vibration, the energy involved when the atoms form the link, the angles between the valencies, and the dipole moments of the links.

*The Journal of the Institute of Metals* Vol 47  
*Metallurgical Abstracts and Index to Volumes 45, 46, and 47 of the Journal* Edited by G Shaw Scott Pp viii+854 (London Institute of Metals, 1932) 80s

THIS is the first volume of the metallurgical abstracts to appear in the new form. The *Proceedings* are now published in separate volumes, and the abstracts, which are issued monthly to members, are collected into a single annual volume. This change has made for rapidity of publication. It brings with it the disadvantage that abstracts relating to a particular section of metallurgy are no longer found in a single group, but have to be sought under a number of monthly sections. It is, however, easy to find these from the table of contents, and perhaps in future years some means may be found of overcoming this drawback.

As before, the literature of the subject has been very thoroughly searched, and the abstracts are in general accurate and informative. It may be suggested that the net has been cast, on the whole, rather too widely, and that many papers are abstracted which contain nothing new. In view of the enormous number of journals dealing with the metal industries, some of them of a very ephemeral character, judicious pruning would seem to be advisable. The reader will be struck by the extensive output of metallurgical work from Russia, which has been multiplied in a remarkable degree within the last year or two.

*Rotation of a Rigid Body in Quantum-mechanics*  
By H Casimir Pp 100 (Groningen B J B Wolters, 1931)

A VERY useful account, in English, of the rather difficult mathematics underlying the theory of the quantum-mechanical motion of a rigid body is given in this monograph. The theory is, of course, essential to the proper understanding of molecular spectra, and the exposition now published is Dr

Casimir's thesis submitted for his doctorate at Leyden. The monograph does not deal with applications to any actual molecule and is by no means easy to read, but it does collect together, in a conveniently accessible form, accounts of the various mathematical methods by which the problem may be attacked, showing their equivalence, and laying special stress on the general symmetry properties of the resulting wave functions. For the specialist who wishes to study the theory of complex molecular spectra in detail (for whom the monograph was written) it should prove of great value. It is full enough to serve his purpose itself as a book of reference on most points, and for deeper study gives him the appropriate references. It is most important that in a new and growing subject such as this, the theory or definite sections of the theory should be written up again and again from every possible angle. Even the theoretical physicist with merely a general interest in the subject of molecular spectra will find much that is instructive and interesting to him brought together in this monograph, the appearance of which we heartily welcome.

*Einführung in die Erd- und Landschaftsgeschichte mit besonderer Berücksichtigung Süddeutschlands*  
Von Prof Dr Georg Wagner Pp 622+176 Tafeln (Öhringen Ferdinand Rau, 1931) 20 gold marks

THERE can be few introductory works that are more sumptuously illustrated than this, which has 503 figures, 23 page-figures of fossils, and 176 photographic plates, these latter showing for the most part two or more subjects. The figures are bold and clear, and many of the plates are from aerial photographs, so that the book is well worth looking through even by one unfamiliar with the German language.

The first part is concerned with geological processes, and here most attention is properly directed to the work of water. In the second part, dealing with earth-history, we find historical geology treated in good modern fashion, considerable emphasis being laid on facies differences, palaeogeography, economic products, and the development of landscape. Though, of course, many examples and illustrations are drawn from south Germany, the discussion of both the physical and historical aspects of the subject is by no means confined to this area, but ranges world-wide. The book summarises the modern outlook on many aspects of geology and will repay reading by teachers of the subject.

*Comparative Anatomy of Vertebrates an Outline of a Laboratory Course* By Herbert W Rand Pp 78 (Cambridge, Mass Harvard University Press, London Oxford University Press, 1931) 6s net

A BRIEF laboratory handbook based on the familiar outline of G. H. Parker, devoted to the descriptive anatomy of a typical amphibian, reptile, and mammal. To what extent such outlines instil enthusiasm for truth, critical analysis, and logical deduction is doubtful.



# Meteorite Craters

By Dr. L. J. SPENCER, F.R.S.

THE famous Meteor Crater near Cañon Diablo in Arizona (Fig. 1) is now generally believed to have been formed by the impact of a gigantic meteorite, though it still remains a subject for discussion. A good account of the crater was given by the late Sir Lazarus Fletcher in *NATURE* in 1906 (vol. 74, pp. 490-492). It is a cup-shaped depression measuring three-quarters of a mile across and with a depth of 570 feet. The rim rises gently from the surrounding desert plain to a height of 130 to 160 feet, and is strewn with huge blocks of sandstone and limestone and much fine debris. The strata exposed in the inner walls dip radially outwards from the centre, while in the surrounding country the bedding is horizontal. Around the crater, within a radius of six miles, thousands of masses of metallic nickel-iron (containing nickel, 7.33 per cent) have been collected since the first discovery in 1891. The masses found range in weight from a fraction of an ounce to 460 kilos (1014 lb.). Estimates of the total amount gathered up range from six to twenty tons. Nearly four tons of this material are preserved in the larger meteorite collections of the world. Some of the masses are surrounded by a crust of laminated 'iron-shale', which has evidently been formed by the rusting of the iron; and fragments of such material are found in abundance. Inside the crater only four smaller masses have been found, but there are indications of the 'iron-shale'.

A point of special interest about these Cañon Diablo irons is the presence in some of the masses of small diamonds, both black and white; and it was doubtless this observation that suggested to H. Moissan his experiments on the artificial production of diamond. Moissan also detected in the iron the presence of native carborundum (silicon carbide), which as a meteoric mineral has been named moissanite. Other rarer constituents of this meteoric iron are platinum metals. One assay yielded platinum 3.65 and iridium 14.95 grams per metric ton, but some other later trials gave negative results.

The view that the crater was formed by the impact of a gigantic meteorite, perhaps 500 feet in diameter and weighing more than a million tons, led to the belief that such a mass would be found buried in the crater and would well repay mining operations. Mining claims were taken out and several trial borings were put down in the centre of the crater. In the bore-holes undisturbed rock was met at depths of about 650 feet, but nothing of value was found—only traces of oxidised iron and nickel. Another bore-hole was put down

several years later under the southern wall of the crater, on the supposition that the meteorite had entered at a slanting angle; but again without any decisive result. After passing through 30 feet of iron-shale cementing fragments of metamorphosed sandstone, the drill stuck, at a depth of 1376 feet, presumably against some hard object, which was thought to be perhaps the main mass of the meteorite. In these borings there was encountered a large amount of 'rock-flour', consisting of crushed grains of quartz from the sandstone; and, in places, some pumice-like material, consisting of silica-glass, which was no doubt formed by the fusion of the sandstone.

In this region there are no volcanic rocks and no indications of volcanic or solfataric activity, so

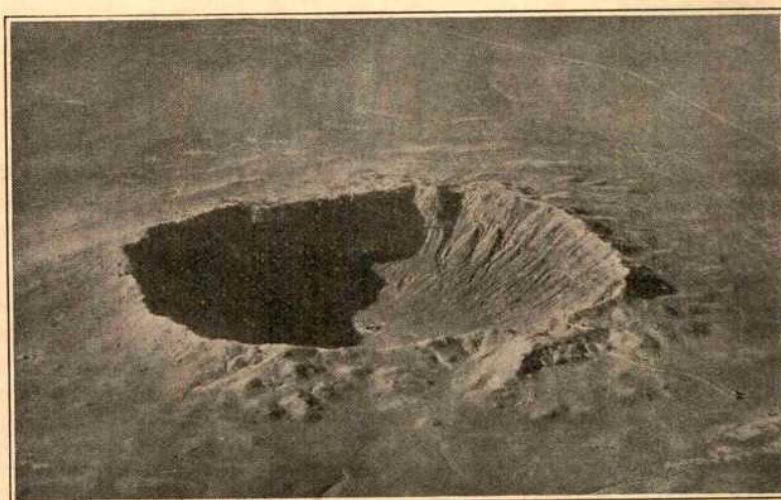


FIG. 1.—Meteor Crater, near Cañon Diablo, Arizona. Air photograph from north-west of the crater, almost in the direction and angle at which the meteorite is supposed to have struck. From the *National Geographic Magazine*.

that a volcanic origin of the crater is ruled out. The idea that it was formed by a steam explosion is, also, not supported by the facts; and still less a recently expressed opinion that the crater owes its origin to the solution of the limestone and is of the nature of a sink-hole. The intimate intermingling of huge blocks and finely powdered sedimentary rocks with meteoritic material indicates that there must be a close connexion between the fall of a meteorite and the formation of the crater; and the fusion of the sandstone, giving silica-glass, could no doubt have been effected by the heat generated by the impact of the mass. With the development of a temperature (1400°-1800° C.) sufficient to fuse quartz, and the presence of water in the surrounding rocks, explosive action from this secondary cause must have helped in making the crater and scattering the fragmentary material. Such a 'back-fire' would explain why the meteorite fragments are found only outside the crater, and it may also be the cause of the upward tilting of the strata in the crater-walls.



A small meteoric stone entering the earth's atmosphere with planetary velocity (up to 45 miles per second) is quickly checked by the resistance of the air, and it reaches the earth's surface with the velocity of an ordinary falling body of about 70 metres per second. But with an enormous mass of metal travelling at such a velocity the momentum is much greater, and it would be difficult to conceive what would be the actual state of affairs (any unfortunate observer would have no opportunity of recording his observations). Meteorites

with the surrounding ground, and around it there is no sign of a crater.

Until quite recently the crater in Arizona was the only known example of this type of feature on the earth's surface—a feature which, though on a much smaller scale, has been compared with the craters of the moon. In 1921 a mass of meteoric iron was found near Odessa in Ector Co., Texas, and since then it has been noticed that the spot is marked by a crater. This is roughly circular in outline, with an average diameter of 530 feet. The



FIG. 2.



FIG. 3.

#### METEORITE CRATERS AT HENBURY, CENTRAL AUSTRALIA\*

FIG. 2.—View from the south of craters Nos. 6, 7, and 8. The larger trees are in the 'Water Crater' (No. 6).  
FIG. 3.—Panoramic view of the 'Main Crater' (No. 7).

actually observed to fall have made holes in the ground usually not more than one or two feet in depth. The largest meteorite of which the fall has been observed is a stone of 820 lb. which fell at Paragould in Arkansas on Feb. 17, 1930. This penetrated clayey soil to a depth of 8 feet, scattering clods to a distance of 50 feet in the pasture. A stone of 293 kilos (645 lb.) which fell at Knyahinya in Czechoslovakia on June 9, 1866, penetrated to a depth of 11 feet. On the other hand, the largest known meteorites, all of which are irons not observed to fall, have been found by reason of them being partly exposed at the surface of the ground. The 60-ton Hoba meteorite discovered in South-West Africa in 1920 has its upper surface level

rim is about 18 feet above the bottom of the hole, but only 2 or 3 feet above the surrounding desert plain, where horizontally bedded limestone is exposed. The steep inner slopes show the limestone dipping at 20°-30° away from the centre. Numerous pieces of 'iron-shale' and a few small pieces of metal have been found on the surface of the rim. The various suggested modes of origin of this crater that have been discussed include: (1) volcanic explosion; (2) salt dome; (3) expansion by hydration of anhydrite; (4) explosion of gas; (5) fall of a meteorite.

A group of similar but smaller craters on the island of Oesel (Esthonia) in the Baltic has recently been surveyed in detail and borings made. The main crater, in which there is a small lake, is 110 metres across and its rim is 6 metres above the

\* Figs. 2-5 are taken from Mr. A. R. Alderman's paper on the Henbury craters, published in the *Mineralogical Magazine*, March 1932, vol. 23, pp. 19-32.



surrounding ground, while inside the depth is 50-60 metres. On the inside walls the beds of dolomite rock dip away from the centre, and there is a zone of pulverised rock. Six other small craters, 14-39 m.

radially outwards over a radius of 60 kilometres. In the centre of the devastated area was discovered a group of ten craters, with diameters of 10-50 metres and a mean depth of 4 metres. Boring

inside the craters to a depth of 10 metres in the frozen ground yielded no meteorites.

In the instances briefly described above we have two cases of single craters associated with meteoritic material and two cases of groups of craters without meteoritic material. A more recent discovery is that near Henbury, about 50 miles south of the MacDonnell Ranges, in the very centre of Australia. Here a group of thirteen craters is associated with abundant meteoritic material, and the evidence of a connexion between the two is much more conclusive. The locality was visited in May 1931 by Mr. A. R. Alderman, of the University of Adelaide, and his description of the craters is published in the March issue of the *Mineralogical Magazine*. Eight hundred pieces of meteoric iron were then collected. In June 1931, a visit was made by Mr. R. Bedford, of the Kyancutta Museum,

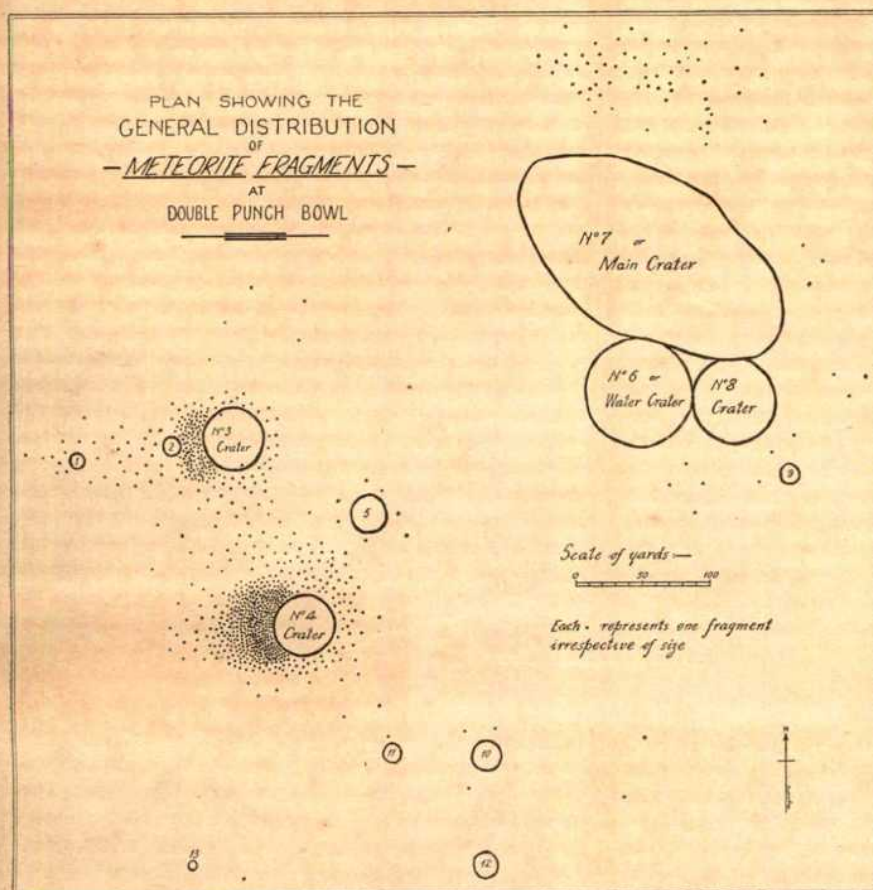


FIG. 4.—Plan showing the general distribution of the craters and of the meteorite fragments around them at Henbury Central Australia.

across, are in the vicinity. Suggested origins that have been considered in this case are: (1) artificial earthworks; (2) gas explosion; (3) oozing out of a bed of clay; (4) Karst weathering of the dolomite; (5) expansion of salt or anhydrite; (6) fall of a meteorite. In this case no trace of meteoritic material was found, but in spite of this, a meteoric origin of the craters has been thought probable.

The great Siberian meteor of June 30, 1908, left its mark in a series of craters in the ground, but no meteoritic material has been found. Expeditions to the inhospitable region on the Stony Tunguska river in central Siberia were led to the spot by the devastation of the pines, forest trees being felled

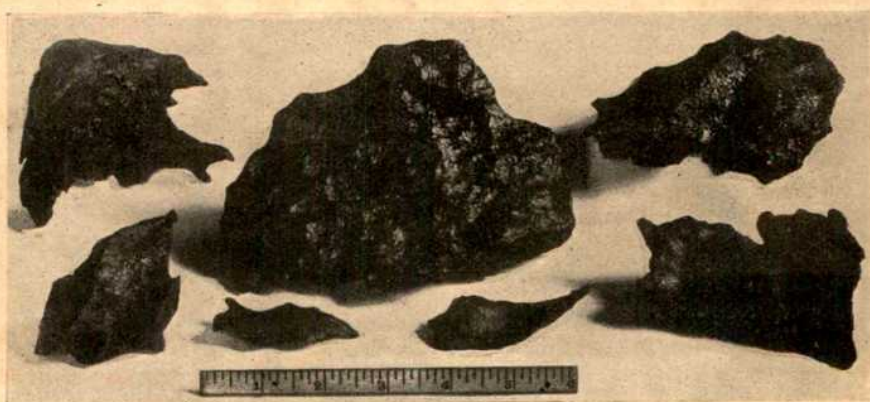


FIG. 5.—Typical fragments of meteoric iron from the meteorite craters at Henbury, Central Australia (with scale of inches).

South Australia, who has sent 542 pieces of the iron, together with fragments of 'iron-shale' and scoriaceous silica-glass, to the British Museum (Natural History). A selection of Mr. Bedford's material is now exhibited on loan in the Mineral Gallery of the Natural History Museum at South Kensington.

The Henbury craters show an irregular distribution within an area of half a mile square. The three larger ones are adjacent, and the largest measures 220 by 120 yards across, with a depth of 50 to 60 feet. The others are approximately circular in outline, with diameters ranging from 10 to 80 yards. Owing to the craters acting as collecting pans for rain-water in this arid region, the spots are marked by the growth of mulga trees, acacias, and coarse grass. This helps to locate the craters, which with their gently sloping outer surfaces are not very conspicuous until the interior is viewed from the edge of the rim. Radiating outwards from some of the craters into the plain are five or six low ridges of sandstone, which may have some relation to the percussion of the meteorites. The steep inner walls of the craters consist of powdered rock and shattered blocks of sandstone, quartzite, and slate. The masses of iron found scattered around these craters range from a fraction of an ounce to 170½ lb. in weight. In one area of 6 feet by 6 feet more than a hundred pieces were collected. Many of the smaller pieces are flaky and shell-like, and are probably the result of the breaking down of larger masses by weathering. Laminated 'iron-shale' in pieces up to several pounds in weight has been found in association with the irons, and it is evident that this has resulted by oxidation of the

iron. As at the Meteor Crater in Arizona, it is remarkable that very little meteoritic material has been found within the crater-walls. Here only two pieces of iron have been found inside one of the craters; and in one of the smaller craters a bore-hole through fine silt down to coarse rock fragments at a depth of 8 feet yielded no mass of iron. Outside the craters were found some fragments of scoriaceous glassy material, which in micro-sections is seen to consist of silica-glass impregnated with iron oxide. This resembles the Arizona material, and was no doubt formed by the fusion of the sandstone by the impact of the meteorite.

At Henbury, with the numerous masses of iron scattered around several craters, there must have been not a single meteorite, but a shower. Further exploration of the locality is to be made this year, and it is hoped that more data will then be available. In the meantime any speculation on the mechanics of the formation of such craters must involve many assumptions. Mr. Alderman is of the opinion that the craters were formed ages ago, while Mr. Bedford believes that they are comparatively recent. The latter mentions that the old blacks will not camp near the place, and that they call it "chindu chinna waru chingi yabu", meaning "sun walk fire devil rock"; which suggests that the natives have some tradition of the fall.

### Implements of Chinese Fossil Man

THE scientific reports on the discovery of implements and remains of fires in association with the fossil man *Sinanthropus* have now been published by the Geological Society of China.\* It is therefore possible to appreciate the significance of this addition to our knowledge of one of the earliest representatives of the human race. There are no traces of glacial or pluvial episodes in the superficial deposits of eastern China to mark horizons; but the distribution of the fossil mammals seems to show that *Sinanthropus* is of Lower Pleistocene age.†

The disintegrated charcoal from wood fires occurs abundantly in old hearths resembling those which are now familiar in the Palaeolithic settlements of Europe. In one place it is scattered throughout a deposit seven metres thick, and Prof. Breuil remarks that the fire was probably replenished continuously during the long period which is represented by so great a thickness of residue. Among the charred remains are numerous burnt bones and stones, including implements. Deer antlers were cut into short lengths by flakes of stone, aided by burning at the lines of section. The bases of antlers seem to have been used as hammers. The

young antler fixed to a piece of skull was used whole, the base being trimmed for a convenient handle. Bits of brain-case seem to have been made into cups; some of the upper jaws were evidently used as files, and some of the lower jaws as small picks, with the coronoid process as working tip. The long bones were regularly broken for the marrow, and some of them seem to have lost only one end, where a stone would be fixed as in a handle.

The stone implements are rudely made of flakes which have been taken from stones found in the river below, and from quartz which occurs on the opposite side of the valley. They are well described by Mr. Pei, and are illustrated with both photographs and diagrams. They are all small, the largest not more than 15 cm. in greatest diameter, and they are at least as varied in shape as the implements met with in the Mousterian deposits of Europe. There are cores and flakes, showing that the implements were made on the spot, and some of the cores themselves are retouched for use.

As the Choukoutien deposits obviously represent a human dwelling-place, while the only remains of *Sinanthropus* hitherto discovered in them are skulls and jaws, Prof. Breuil discusses the suggested possibility, that the fires and implements were made by a higher type of man who collected the skulls of a lower race as trophies of the hunt. He wisely rejects this suggestion, and looks forward to the discovery of numerous still more primitive ancestral men with real human intelligence.

\* D. Black, "Evidences of the Use of Fire by *Sinanthropus*", *Bull. Geol. Soc. China*, vol. 11, pp. 107, 108; 1931. H. Breuil, "Le Feu et l'Industrie Lithique et Osseuse à Choukoutien", *tom. cit.*, pp. 147-154 (also in *L'Anthropologie*, vol. 42, pp. 1-17; 1932). W. C. Pei, "Notice of the Discovery of Quartz and other Stone Artifacts in the Lower Pleistocene Hominid-bearing Sediments of the Choukoutien Cave Deposit", *tom. cit.*, pp. 109-139, pls. I-III.

† W. C. Pei, "The Age of Choukoutien Fossiliferous Deposit", *Bull. Geol. Soc. China*, vol. 10, pp. 165-178; 1931. C. C. Young, "Die Stratigraphische und Palaeontologische Bedeutung der fossilen Nager-tiere Chinas", *tom. cit.*, pp. 159-164, with 3 tables.



Piltdown man (*Eoanthropus*) is at least as old as *Smantropus*, if not older, and was shown long ago by Mr Charles Dawson and myself to have made both stone and bone implements, and to have split bones, doubtless for extracting the marrow. More recently, burnt flints have been

noticed in the Piltdown gravel, and not long ago I found one such flint which is indistinguishable from the 'pot boilers' of later periods. The beginning of human arts, indeed, dates back to immense antiquity, before man had assumed his present form.

A SMITH WOODWARD

### Obituary

SIR WILLIAM WATSON CHEYNE, Bt, F.R.S.

IN spreading the doctrines and technique of antiseptic surgery, Joseph Lister had no more efficient nor more ardent disciple than William Watson Cheyne, who died, after a long illness, on April 19 last, in the eightieth year of his age. From very humble beginnings, Cheyne, by sheer ability, perseverance, and high principle, reached the summit of the surgical profession in Great Britain and commanded the respect of the whole medical world.

Not only was Cheyne a practical operating surgeon, but under the influence of Lister he was also a pioneer of bacteriological research in England, and did more than anyone else to diffuse the bacteriological knowledge which in the seventies and eighties of last century had accumulated at an astonishing rate in Germany and France. In this advance, England played almost no part, if we except Lister himself. At first we concerned ourselves with research in histology and physiology, and at a later period the energy of English workers was directed by the writings of Virchow and the growth of the cellular pathology. We had not learned the snares of bacteriological technique, and even Lister himself, working alone and with imperfect methods, fell into bacteriological errors which, however, he later handsomely admitted and corrected. Watson Cheyne was closely associated with Lister, and although he did not publish many separate memoirs on bacteria, he incorporated much original research in his surgical works and particularly in his "Antiseptic Surgery: its Principles, Practice, History, and Results", 1882, pp 616.

Cheyne also did much to introduce English students to bacteriology by his translation of the second edition of Flügge's famous "Fermente und Microparasiten". This translation was published in 1890 by the New Sydenham Society under the title "Micro-organisms with Special Reference to the Etiology of the Infective Processes", and ran to 826 pages. Cheyne also edited an important collection of classical bacteriological papers under the title "Recent Essays by Various Authors on Bacteria in Relation to Disease", 1886. By these works Cheyne became widely known, but at a relatively early date he was forced to relinquish his scientific work as he had to earn his living. In those days there were no whole-time paid pathological—far less bacteriological—posts in the country except in the four Scots universities. Cheyne therefore took up surgery as a practical profession, but he continued to be a voluminous writer, and most of his writing was of high medical

quality. One of his chief works was that in conjunction with F. F. Burghard, and entitled "A Manual of Surgical Treatment", second edition, 5 vols, 1912–1913. For many a day this was a standard work.

As a spectacular operator, Watson Cheyne could not be classed alongside several surgeons even in his own day, but he did all his work in the most conscientious way, and the welfare of his patient was his first and last concern. He thus early acquired a name for surgical rectitude, and his opinion and skill were soon in such demand that he acquired a very large practice, and for many years led an exceedingly busy and useful life. Lister's mantle may be said to have fallen upon Watson Cheyne, who bore it nobly and well, and the pupil was a credit to the great founder of the antiseptic principle in surgery.

Sir William Watson Cheyne was born—at sea it is said—on Dec. 14, 1852, the son of Andrew Cheyne and his wife Eliza, daughter of the Rev. William Watson, minister of the far-away island of Fetlar in Shetland, and in the manse of this wind-swept island Cheyne spent his boyhood and learned to love the sea. He always visited Shetland whenever he could, and after the *Sturm und Drang* of a long professional and busy life in cities, he retired to the Ultima Thule where he had spent so many happy years, and settled once more in Fetlar until a year or two before he died.

Cheyne studied medicine in Edinburgh and graduated M.B., C.M. there in 1875. He then went to Vienna and Strassburg, and thereafter he became house surgeon to Joseph Lister, at that time professor of clinical surgery in Edinburgh, and nearing the height of his fame. When, in 1877, Lister was invited to take up the duties of surgeon at King's College, London, he asked Cheyne to accompany him to be his first house surgeon. Cheyne took the F.R.C.S. diploma in 1879, and in due course was elected assistant surgeon at King's College Hospital. He finally reached the position of consulting surgeon and retired.

When the South African War broke out Sir William at once volunteered for active service and was appointed a civil consulting surgeon. In the War of 1914–1918 he was at first Consulting Surgeon to the Royal Navy and, later, Surgeon-General, R.N. Finally, in 1918, he attained the rank of Surgeon Rear Admiral. He was created baronet on July 20, 1908, and was appointed Surgeon-in-Ordinary to H.M. the King. In 1914 he was elected president of the Royal College of Surgeons, and he was the first recipient of the Lister Memorial Medal in recognition of his distinguished contributions to surgical science. Retiring from practice, he was

elected M P for the Universities of Edinburgh and St Andrews in 1917, and in 1918 he became M P for the Scottish Universities

Sir Wilham was married twice, and is succeeded in the baronetcy by his elder son, who bears the name of Joseph Lister Cheyne W B

#### MR A M LEA

A FINE naturalist and a lovable man passed away, suddenly and painlessly, from cerebral hæmorrhage, at Adelaide on Feb 29 Arthur Mills Lea, born at Sydney sixty-three years ago, at an early age collected butterflies Leaving the State school when still a boy, and encouraged by the veteran collector and curator, the late George Masters, he extended his field of action to beetles and other insects, and soon every spare moment was given to collecting and taking infinite trouble to get his specimens identified

Lea's first post was that of assistant entomologist to the late A Sidney Oliff, in 1891 Four years later he was selected as Government entomologist to Western Australia, and in 1899 was promoted to a similar position in Tasmania Here he established a high reputation as an economic entomologist in the great fruit-growing State But throughout, Lea always used his opportunities and spare time in diligent collecting and classifying his favourite order, the Coleoptera, especially studying the most difficult family of all, the weevils—so intimately associated with plant life He soon became the Australian authority on this group, and to-day more than 2000 Australian and New Guinea weevils have been described and named by him (about twice as many as the number recorded in Masters' Catalogue of 1886)

In 1911, Lea was appointed entomologist to the South Australian Museum where he made the insect collection one of the finest in Australia—its value greatly enhanced by the large number of his added types In 1924 he was given a year's leave of absence to undertake a research on behalf of the *Levuana* Committee, when the moth of that name threatened the Fiji copra industry, and he traversed Queensland, New Guinea, Java, Malaya,

and Borneo in the study of a biological control of the pest

For many years Lea was the centre of inquiry from entomologists the world over, on determinations and nomenclature of insects His work extended over the whole order, including especially the important families of Scarabæidæ, Chrysomelidæ, Coccinellidæ, and Malocodermidæ In a word, Lea's close and detailed knowledge of Australian insects raised him to a unique position This was the more praiseworthy as being almost wholly the result of self-help and sustained industry, for it included the study of Latin, French, and German, languages not learnt at school, and a special gift for drawing, utilised in his numerous papers Lea described *no less than 5432 species of insects*, chiefly Australian, but including many from New Guinea, Fiji, New Caledonia, Lord Howe and Norfolk Islands Idle moments were unknown to him Daylight was fully utilised for the examination of material, evenings for correspondence or preparing manuscript for publication Yet he found time to serve on the Council of the Royal Society of South Australia and to act as assistant editor of its *Transactions* His loss is irreparable, for no other man possessed a tithe of his wide knowledge of the Australian insect fauna, nor would be so generous of help Like most enthusiasts, Lea had a special faculty for inspiring enthusiasm in others H J CARTER

WE regret to announce the following deaths

Mr R H Adie, formerly secretary of the School of Agriculture, University of Cambridge, on May 18, aged sixty-seven years

The Hon Mrs Huia Onslow (Muriel Wheldale Onslow), University lecturer in plant biochemistry in the University of Cambridge, on May 19

Dr Goddard H Orpen, president of the Royal Society of Antiquaries of Ireland, and an authority on the early history and antiquities of Ireland on May 15, aged eighty years

Dr J C Thresh, formerly medical officer of health to the County of Essex, and an authority on public water supplies, on May 23, aged eighty-one years

### News and Views

#### Evariste Galois

"No episode in the history of thought", says Dr G Sarton, "is more moving than the life of Evariste Galois—the young Frenchman who passed like a meteor about 1828, devoted a few feverish years to the most intense meditation, and died in 1832 from a wound received in a duel at the age of twenty He was still a mere boy, yet within these short years he had accomplished enough to prove indubitably that he was one of the greatest mathematicians of all time" The tragic story of Galois was told by Dr Sarton in the *Scientific Monthly* for Oct 1921 Born at the village of Bourg-la-Reine near Paris on Oct 25, 1811, he was the son of a schoolmaster and mayor, who had married a lawyer's daughter of good education, said

to have been "generous to a fault and original to the point of queerness" Taught at first by his mother, in 1823 Galois was sent to the Collège Louis-le-Grand, and after twice failing to gain admission to the École Polytechnique, in 1829 entered the École Normale At school he had been conspicuous for the qualities he had undoubtedly inherited from his mother, and was little understood by his teachers "The *furor* of mathematics possesses him", one of them wrote His career at the École Normale was short Embittered by his failure to attract attention to his work, and distracted by the suicide of his father, he became embroiled in political discussion and he was expelled His outspoken republicanism afterwards led to his imprisonment, and to his youthful miseries was added



that of an intrigue, which probably led to the duel which cost him his life. The duel took place on the early morning of May 30, 1832, and he died next day in the Hôpital Cochin. His complete works fill only sixty-one small pages, but a French geometer, publishing a large volume some forty years after Galois' death, declared that it was simply a commentary on the latter's discoveries.

#### Faraday and Benzene

THE Royal Institution audience at the Friday evening discourse on May 20 had a stimulating experience when Prof. Henry E. Armstrong addressed them with "Faraday at the Sign of the Hexagon" as his subject. "Coal Colour and Constitution" was the alleged theme of the evening, but this venerable Lewis Carroll of chemistry allowed himself freely to be led only by the spirit of the moment. With the lecture room decorated like an Eastern bazaar, with fabrics of every pattern and hue, the 'lecturer' was evidently content to appear as a benevolent 'high priest of colour', wearing himself as regalia a waistcoat of the genuine nursery sky blue and pink. The ordinary symbols of the orthodox chemist were discarded for this occasion, "as people won't take the trouble to understand their meaning", so straight-chains and ring compounds were replaced by the backbone of a mackerel and by a whiting with tail in mouth ready for the kitchen, also buttons on safety-pins deputed for the unwieldy formulæ of the dyes chemist, all used to illustrate the genealogy of benzene, that "pallid infant of the sober Faraday", "taken as mistress by Hofmann", with progeny the "gentle Aniline" and her numerous offspring whose "hectic and chromatic careers" were vividly described. Nor must Miss Hook of Holland be forgotten, who left her seat by the chairman to display her famous many-hued petticoats, as illustrations of the dyes which the chemists' control of colour has produced from the same base.

#### Statue to Trevithick

ON May 17, at Camborne, Prince George unveiled a statue of the eminent Cornish engineer, Richard Trevithick, which has been erected in front of the Free Library. Trevithick was born in the neighbouring parish of Illogan in 1771, but soon after his birth his parents removed to a cottage in Camborne, which is now being preserved as a memorial, and after his marriage Trevithick himself had a house and workshop in Fore Street. Like his father, he was a mine engineer, but he will always be remembered as a pioneer in the use of high pressure steam and of the locomotive. The statue which has been erected depicts him holding a model of his first road locomotive. Previous to the unveiling of the statue, Prince George had attended a luncheon at the Camborne School of Mines, at which there were representatives of the county of Cornwall, various engineering and scientific societies, and the railways. The project for raising a memorial to Trevithick was started in 1911, but owing to the War and other causes its completion has been much delayed. The other memorials to Trevithick include a window in Westminster Abbey, a scholar-

ship at the University of Manchester, the Trevithick premium of the Institution of Civil Engineers, and the tablet in Dartford Parish Church, in the grounds of which he was buried in April 1833.

#### British Broadcasting

In a thoughtful address at the Royal Institution on May 13, Sir John Reith indicated some of the reflections and conclusions forced upon him by his ten years' experience of broadcasting. These bore mainly upon the influence of the peculiar constitution of the British Broadcasting Corporation upon its effectiveness and success. The rationalised nationalisation of that body gives it freedom from the cramping and cumbersome system of a government department, while yet retaining a certain degree of public control. It can proceed to carry out the terms of its commission as unhampered as any private enterprise, but the objections to private enterprise are eliminated by the public control of matters of major policy. Monopoly, Sir John regards as an essential of the efficient national system not only on economic and administrative grounds, but also because competition in broadcasting reduces programmes to the level of the greatest demand, and that would have cut out much of the service to music and education which the B.B.C. has been able to render. Finally, personal direction by an individual aware of his responsibility and having the courage of his convictions, leads, as no form of government depending upon the suffrages of electors can lead, to decisive and consistent action.

UNDER such a regime, Sir John Reith foresees a great future for broadcasting. It is not without significance that so many other countries have, with adaptation to local needs, copied the work and form of the B.B.C. Britain appears to have sensed in this respect a need that was common to all nations belonging to the European culture, perhaps because through this system democracy may at last be able to come to its own. Nationally, he said, this obtains because the peculiar nature of the medium imposes sincerity and moderation on speaker and thoughtfulness on hearer, and because those who have something real to contribute to society are brought into direct contact with, not the masses, but the individual members of that society. Internationally, it obtains because ether waves do not stop at frontiers, so that the foreign listener must come, if not to agree with, at least to respect, points of view different from his own, presented to him with the sincerity that carries force and without the violence that provokes it.

#### The Expanding Universe

IN his Ludwig Mond lecture, delivered at Manchester on May 9, on the subject of "The Expanding Universe", Sir James Jeans began with a review of the system of galaxies, our knowledge of which has been greatly extended by recent work with the 100-inch reflector at Mt. Wilson. From these results, he concludes that some two million nebulae lie within a distance of 140,000,000 light-years—a sphere of observation which bears the same ratio to the whole

of space as the Isle of Man to the whole surface of the earth. Reference was then made to the conclusions of Friedmann and Lemaître that the equilibrium of such a universe would be unstable, and if expansion started it would continue. Sir James conjectures that the initial impulse which started the expansion may have arisen in the process of the condensation of the primeval chaotic gases into nebulae. Spectrograms of the distant galaxies indicate such an expansion, the rate of recession being about 105 miles per second at a distance of a million light-years, and increasing in the same proportion as the distance, so that it attains the amount of 15,000 miles per second for the most distant nebula yet measured.

ALLUSION was then made to the difficulty of reconciling this rapid recession with a past duration of the universe extending to millions of millions of years. Sir James has himself given strong reasons in favour of such a past duration, but he now admits that it may be necessary to abandon it. There are, however, some alternatives, there might have been a long period before the recession got fairly started, or the spectral shift that appears to indicate recession may be due to some other cause. Allusion was made to Sir Arthur Eddington's attempt to evaluate the cosmical constant, and so obtain a theoretical value for the rate of expansion, he obtained a value quite close to the observed rate. Sir James noted that this result, while intensely interesting as linking up the largest and the smallest objects of observation, is still a matter of controversy, and cannot be accepted as certain.

#### Hughlings Jackson Memorial Medal

DR HUGHLINGS JACKSON, who died in 1911, gave the first Hughlings Jackson lecture that was founded in 1897 in his honour by the Neurological Society of London. With a few intervals, as during the War, this lecture has been given triennially, by an eminent neurologist or physiologist. Last year the Section of Neurology of the Royal Society of Medicine decided to form a fund to endow the lectureship with a gold medal and an honorarium of a hundred guineas triennially, and subscriptions were invited by a committee of which Mr Leslie Paton was chairman and Dr Wilfred Harris treasurer, 146 subscribers from many parts of the world produced a sum of just over £1200, which has been handed over to the Royal Society of Medicine, after paying for the design of a gold medal by Mr Percy Metcalfe, the work being carried out by the Royal Mint. Sir Charles Sherrington, who gave the last lecture, on "Quantitative Management of Contraction in Lowest Level Co-ordination", has been awarded the first medal.

THE first Hughlings Jackson Memorial Medal, with the honorarium, was formally presented to Sir Charles Sherrington on Thursday, May 19, by Dr Watts Eden, president of the Royal Society of Medicine. Before doing so, Dr Stanley Barnes, president of the Section of Neurology, introduced Sir Charles Sherrington as an original member of the Neurological Society in 1886, and referred to Sir Charles's fame as an experi-

menter. He also called upon another original member of the Society who was present, Sir James Crichton-Browne, to give some personal recollections of Hughlings Jackson. Sir James recalled that in the early 'seventies Jackson had regularly visited the West Riding Asylum at Wakefield, where Sir James was then medical superintendent, and contributed several articles to their reports. After Sir James left Wakefield for London, he, with Hughlings Jackson, Ferrier, and Bucknill, founded the neurological journal, *Brain*. After Sir Charles Sherrington's reply, thanking the Royal Society of Medicine and the Fund Committee for their valuable prize, Mr Leslie Paton presented Dr Watts Eden, for the Royal Society of Medicine, with two replicas of the Jackson Medal, in toned silver, suitably framed.

#### Two-way Television

WHEN the possibility of television was recognised, the first application that suggested itself was to show the image of a person hundreds of miles away. A natural development was to superpose a television on a telephone system so that the hearer could both see the speaker and hear him talking. This latter method is used daily by the B B C in the television radio broadcasts. A successful experiment showing the combination of ordinary telephony with two-way television was demonstrated to the Press in Paris on May 19, and an account of it appeared in the *Times* on the following day. The television apparatus used was supplied by the Baird Television Corporation. Infra-red rays are obtained by filtering artificial light through ebonite screens. They fall on both the speaker and the hearer. Only invisible rays are used to produce the electrical impulses in the connecting wires. At the ends of the line they are converted into light rays and focused on screens. It is difficult for either the speaker or listener to realise that his head and shoulders are in full view of the other. The visual screens are ten inches long by five inches broad. As the scanning disks make 750 revolutions per minute,  $12\frac{1}{2}$  complete images per second appear on the visual screen. At this speed there is little flickering. The features are easily recognisable and the play of expression on the face is remarkably clear. The movement of the lips can easily be followed. If necessary, the 'fineness' of the images could be improved by increasing the number of dots. In the near future, public communication combined with television on a commercial basis will be started between Paris and Lyons. The Baird-Nathan Company is exploiting this system in France, and later on it is hoped to connect Paris and London in this way. A form of two-way television was demonstrated in New York by the Bell Telephone Co. on April 9, 1930 (*NATURE*, May 31, 1930).

#### London Power Supply

THE Central Electricity Board was created by the Act of 1926, and was given great powers to co-ordinate generation throughout the whole of Great Britain, including the London area. In 1929-30 the load for this area, excluding the railway and tramway re-

quirements, was supplied by 58 generating stations. Of these stations, 27 small ones supplied only four per cent of the total load, the average generating cost per unit being more than 1 5d. Five groups of large stations supplied 66 per cent of the total load, the average generating costs being 0 466d per unit. When the extensions at Barking and the new stations at Battersea and Fulham come into operation, even better results will be obtained by the larger stations. The fundamental geographical feature from the point of view of electrical generation is the Thames Valley, with its abundant supply of water for condensation purposes and its facilities for the transport of waterborne coal. In a lecture by J. D. Peattie, published in the *Electrician* for May 6, an account is given of the interconnexion of the generating stations in the London area. Within a radius of ten miles from Charing Cross, there are now hundreds of lattice towers supporting stranded cables for the grid at 132 kilovolts and for connecting stations at 66 and 33 kv. There is a notable river crossing between Barking and Northfleet, where two towers, 487 feet high, will give a clearance under the wires at high water of 250 ft on a span of 3060 ft. These towers are the highest on the grid and will carry two double circuits. They are specially painted, and will be illuminated at night to give warning to aircraft flying along the Thames Valley. On the way to Southend one of them is now a conspicuous landmark.

#### The Hannah Dairy Research Institute

A BRIEF account of the researches already carried out at the recently established Hannah Dairy Research Institute, Kirkhill, Ayr, is given by the director, Dr N. C. Wright, in the *Ayrshire Cattle Society's Journal*, vol. 3, No. 1. An investigation into the incidence of certain bovine diseases, especially tuberculosis and milk fever, has been commenced, and, as a result, recommendations have been made which should lead to the elimination from tested herds of a large proportion of the animals reacting positively to the tuberculin test. Inquiry is also being made into the length of life of milking cows in Scottish herds and into the main causes which lead to the unremunerative disposal of stock. The problems of the utilisation of surplus milk and of milk by-products also received attention. Investigations on the biological side require laboratory accommodation, which has only recently become adequate with the completion of the buildings at Kirkhill. They will include a re-investigation of the protein requirements of dairy cows, and an investigation of the physiology of lactation. In addition, the problems involved in improvement of the dairy stock by selective inbreeding and in the methods used in condensing and drying milk, separated milk, and whey will be examined. Two-thirds of the income of the Institute is received in the form of a grant from the Development Commissioners, but the remaining third must be raised from non-government sources. It is estimated that £2000 will be required annually, and it is hoped to secure an endowment fund which will supply an assured income of this order.

#### Anthropological Bibliography

ANTHROPOLOGY in particular among the sciences is not well served in the matter of indices and bibliographies, though what is needed is, perhaps, co-operation rather than extended effort. There is already in existence a number of bibliographies dealing each with some one or more departments of anthropological science. Some of these overlap, and none can be called really complete. The latest of these has been compiled by M. Joseph Nippgen, librarian of the Société de Géographie of Paris, and has appeared in *L'Ethnographie*, it may be obtained separately from the Société d'Ethnographie de Paris. It covers contributions to general and comparative ethnology, and folklore and comparative religion, while ethnographical papers and books dealing with specific geographical areas are grouped under continents. A few items in archaeology and physical anthropology are included. This bibliography has the additional advantage that a considerable number of the items are analysed at some length by the compiler. There is, unfortunately, no indication of the period of publication covered by the compilation as a whole, though the latest date appearing is 1929. The current issue of *L'Anthropologie* (T. 40, Nos. 5-6) is devoted entirely to an index of vol. 21-40 of that periodical, issued for the years 1910-31. The index is divided into two parts, of which the first contains a list of authors in alphabetical order and the second is a subject index. Titles of original communications and *variétés* are distinguished from book reviews by a difference in type, but no distinction is made between the names of authors of books reviewed and of original communications. In consequence, the arrangement gives undue prominence to what, from the point of view of most who will wish to consult *L'Anthropologie*, must be regarded as much in the nature of second-class matter. Notwithstanding this inconvenience, the index is a great boon, and an example that might well be followed with advantage by many more of the British scientific periodicals which have a long run.

#### New Mayan Site in Yucatan

A RUINED Mayan city of enormous proportions, previously unknown, has been discovered in southern Yucatan by Mr. C. L. Lundell, a representative of the American Chicle Development Company. The ruins are situated in the south-east corner of Campeche and are difficult of access, but under an arrangement with the Mexican Government they have been inspected by Dr. Sylvanus G. Morley, accompanied by a party of five. The city has been named Calakmul, "The Two Adjacent Hills", by its discoverer. In Dr. Morley's report, as circulated by Science Service, of Washington, D.C., the site is said to contain many more sculptured monuments than any Mayan city hitherto known. There are no less than one hundred and three stelæ with sculptured figures and hieroglyphs. Some of the stelæ are of high artistic merit. Fifty-one are dated, and one-half of these have been deciphered. It is evident that the city was once a

great religious centre and a place of outstanding importance in the Old Empire of the Mayas

#### Neanderthal Man in Palestine

A CABLE received by Miss D A E Garrod, director of the joint expedition of the British School of Archaeology in Palestine and the American School of Prehistoric Research, announces a further discovery of skeletons in the Mugharet-es-Sukhul cave by Mr T McCown. With those previously discovered, the number of individual skeletons now amounts to seven, presumably the relics of a collective burial. The remains are enclosed in a hard breccia in which are also found a large number of stone implements of Mousterian type.

#### New Atlantic Flight

IN 1928, Miss Amelia Earhart (Mrs Putnam) crossed the Atlantic from west to east in an aeroplane with two others, the late Mr Wilmer Stultz and Mr Louis Gordon. On Saturday, May 21, she landed near Londonderry, Northern Ireland, having completed a flight from Harbour Grace, Newfoundland, in about fourteen hours. Miss Earhart is thus the first woman flying alone to cross the Atlantic, and she has also set up a new record for the shortest time for the flight. Her machine was a Lockheed Vega monoplane with a Wasp engine of 420 h.p. Four hours out from Harbour Grace, a leaky joint developed in the exhaust of the engine, causing other parts to work loose and set up vibration. There was also danger from petrol leaking into the cockpit from the petrol gauge. For about five hours during the night, Miss Earhart was flying 'blind' through bad weather, and during this period her altimeter broke down. In spite of these difficulties, Miss Earhart reached the west coast of Ireland and, being uncertain as to her exact bearings, turned north until she saw the country sloping down to the sea. She landed successfully close to Londonderry.

#### Lewis Evans Collection at Oxford

THE Committee of Management of the Lewis Evans Collection of Scientific Instruments has issued its Annual Report. Details are given of the important collection of astronomical, optical, magnetic, and mathematical instruments presented by the Royal Astronomical Society of London. This collection is especially valuable as illustrating the period in the history of astronomical measuring which immediately preceded the time when photographic methods began to be employed for the accurate determination of stellar positions. A very notable addition to the collections illustrating the original association of the Old Ashmolean Museum with the study of natural history in Oxford has resulted from the discovery of a part of the great Lhwyd collection of fossils, which had been lost for two centuries, in a cabinet deposited with the Lewis Evans Collection by Oriel College. These fossils, most of which are in their original wrappings inscribed with data, are of the highest historic interest as being part of the first geological collection in Oxford, and especially as being the original type

specimens described and in some cases figured by Lhwyd in his classical work on British palæontology.

#### Barn Owl Census, 1932

THE diminishing number of barn (or white) owls in England and Wales in recent years is giving concern to agriculturists and students of bird life. In order to obtain information as to the facts of the case, the Royal Society for the Protection of Birds is instituting a census of barn owls breeding during the summer of 1932, and helpers are required in every part of the country to find out and record where in their own localities the birds are nesting. All who may be willing and able to assist the inquiry by undertaking to report upon a definite area, are asked to communicate with Mr G B Blaker, Gaveston Place, Nuthurst, nr Horsham, Sussex, who is organising the work, and to indicate the extent of the area to be allotted to them. Census forms, with suggestions as to how the work may be carried out most easily and effectively, will then be forwarded. It is hoped that valuable information will thus be obtained as to the status of this useful bird.

#### Prevention of Cherry Fruit Fly

WITH the object of preventing the introduction of the cherry fruit fly into England, the Ministry of Agriculture and Fisheries has issued an order (under the Destructive Insects and Pests Acts, 1877 to 1927) which regulates the importation of cherries during the 1932 season. Cherries grown in France will not be admitted after May 27, except those grown within a small district around Honfleur. Cherries grown in Italy will be admitted until June 5, after which date only those grown in the region of Emilia will be allowed to enter, after June 10, the importation of cherries grown in any part of Italy will be entirely prohibited. Cherries grown in Germany will be admitted until June 26 if accompanied by a certificate of origin, after that date, no German cherries will be admitted except those certified not to have been grown south of lat 53° N or in East Prussia.

#### Important Collections for Harvard Museum

Two great collections have recently been added, according to Science Service, to the Museum of Comparative Zoology at Harvard. John Eliot Thayer has presented his series of thirty thousand specimens of bird skins, forming probably the finest private collection of North American birds. The collection also contains many thousands of nests and eggs. Some of the specimens are very valuable. Extinct birds include the Labrador duck, the Eskimo curlew, and the passenger pigeon. There are ten eggs of the extinct great auk, and several of the California condor, which is becoming very rare. The second collection, bequeathed by Andrew Gray Weeks, contains some 75,000 specimens of butterflies and moths, many being type specimens. The former owner also left to the museum a fund for the care and increase of the collection.

#### Researches from the London Hospital

ANOTHER volume of "Researches", published from the wards and laboratories of the London Hospital

during 1931, has been issued by the Publications Committee, of which Mr Hugh Cairns is honorary secretary. It contains 33 papers, all previously published elsewhere, which range over a wide field in the science and art of medicine. The London Hospital houses a wealth of clinical material, and the staff appears to have made full use of the opportunities for investigation and the publication of adequate records of unusual cases.

#### Ross Institute

THE annual report and accounts for 1931 of the Ross Institute and Hospital for Tropical Diseases, Putney Heath, London, S W 15, shows a serious reduction in contributions in 1931. The Institute at present possesses no endowment fund, and the honorary treasurer, Lord Queenborough, appeals for generous financial support this year. The report also contains a summary of the research work carried out at the Institute, and an account of the results of malaria prevention abroad following measures suggested by the Malaria Department of the Institute.

#### Announcements

PROF C U ARIENS KÄPPERS will deliver the David Ferrier Lecture at the Royal Society on June 2, taking as his subject "Some Correlations between the Brain and the Skull."

THE annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 4, and of the National Physical Laboratory on Tuesday, June 28.

DR E F ARMSTRONG (chairman of Council) and Mr J Davidson Pratt (general manager) have been appointed representatives of the Association of British Chemical Manufacturers at the Imperial Conference at Ottawa.

A JOINT discussion on "Vision" has been arranged by the Physical and Optical Societies, to be held at the Imperial College of Science and Technology, South Kensington, S W 7, on Friday, June 3, at 2.30-5.30 P.M. and 7-9.30 P.M. Twenty-eight papers by leading British and foreign contributors have been promised. Visitors will be welcomed, no tickets are required.

It is announced in *Science* that Dr E C Franklin, emeritus professor of organic chemistry at Stanford University, has been awarded the Willard Gibbs Medal for 1932 by the Chicago Section of the American Chemical Society for his "work on liquid ammonia solutions, [which] opened up an entirely new field, and also modified profoundly our views on aqueous solutions. He has made a life-long study, characterised by insight, thoroughness and experimental skill, of reactions in liquid ammonia."

THE National Baby Week Council announces that 'national baby week' will be held this year on July 1-7. It is suggested that, in view of the present economic crisis, the subject of the economic values of maternity and child welfare work should find a place

in local and national propaganda. The report of the Council for 1931 has been issued and gives details of the work accomplished during the year, the competitions organised in connexion with National Baby Week, and awards of the Baby Week challenge shields and prizes.

THE second supplement to the "Bibliography of Bibliographies on Chemistry and Chemical Technology" has been published by the National Research Council of the National Academy of Sciences, Washington, D C, as Bulletin No 86. This publication, which completes those previously issued in 1925 (No 50) and 1929 (No 71), and noticed in *NATURE*, includes references, classified under subjects, of publications, both books and papers, which contain bibliographies of the subjects. It is a valuable and useful work, which deserves to be widely known, and we are glad to direct attention to the issue of a new supplement.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned—A chief veterinary inspector under the Ministry of Agriculture for Northern Ireland—The Secretary, Civil Service Commission, Stormont, Belfast (June 4). An assistant pathologist at the National Hospital, Queen Square—The Secretary, National Hospital, Queen Square, W C 1 (June 4). A principal of the Cambridgeshire Technical School—The Education Secretary, County Hall, Cambridge (June 6). A lecturer in structural and mechanical engineering at the Constantine Technical College, Middlesbrough—The Director of Education, Education Offices, Woodlands Road, Middlesbrough (June 6). A Morna Macleod research student in biochemistry at the Lister Institute of Preventive Medicine—The Secretary, Lister Institute, Chelsea Bridge Road, S W 1 (June 7). A full-time lecturer in mining technology at the Clowin Mining and Technical Institute—The Director of Education, County Education Office, St Mary's Gate, Derby (June 8). A Duddell Scholar of the Institution of Electrical Engineers—The Secretary, Institution of Electrical Engineers, Savoy Place, W C 2 (June 15). A Rhondda Research Student at Gonville and Caius College, Cambridge (open only to students who are residents or sons of residents in Wales or Monmouthshire)—The Master, Gonville and Caius College, Cambridge. A resident lecturer in biology (including gardening) at the Saffron Walden Training College for Women Teachers—The Principal, Training College for Women Teachers, Saffron Walden, Essex. A Leverhulme fellow for fishery research at University College, Hull—The Registrar, University College, Hull. Part-time lecturers in general biology and physiology, respectively, in the Applied Optics Department of the Northampton Polytechnic Institute—The Registrar, Northampton Polytechnic Institute, St John Street, E C 1. A director of the National Institute of Poultry Husbandry, Newport, Shropshire—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

## Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

### Ionisation at High Gas Pressures

IN connexion with papers by Broxon,<sup>1</sup> Tarrant,<sup>2</sup> and Steinke and Schindler<sup>3</sup> on ionisation in pressure chambers, the results of some experiments on the increase of ionisation by  $\gamma$ - and X-rays with rising gas pressure, up to 150-170 atm, may be of interest. By means of a very simple method<sup>4</sup> of determining the ionisation, the relation of ionisation to pressure has been investigated for air. In this method the insulation material is exposed to the same pressure from all sides during the irradiation. The distance between the electrodes in the chambers used was 0.5, 1.0, and 2.0 mm, and the wall of the chamber was made of brass. The radiation was filtered through about 6 mm of brass. A radium preparation of 50 mgm of radium element at a distance of 4.5-12 cm was used. With X-rays, the investigation was made at a constant voltage of 170 kv.

Even the first experiments with  $\gamma$ -rays gave curves for an electrode distance of 0.5 mm (Fig. 1) which showed good agreement with those recently obtained by Broxon (loc. cit.) for the variation with pressure in cases of cosmic radiation. There was a possibility that the ratio between the mean distances between the electrodes (in Broxon's experiments about 130 mm,

about 7000 volts and 500 volts per cm. The field was practically homogeneous, and no after-effects of ionisation (Steinke and Schindler, l.c.) could be found. Separate experiments proved that at the highest pressures full saturation voltage was not reached. When the voltage was reduced to a quarter or a half, however, the drop in the ionisation was only 10-15 per cent. It is extremely unlikely that the agreement between the curves was due to the current being below saturation value if the ionisation follows the same laws as at lower pressures.

It would seem that the observed variation of the ionisation with the pressure could scarcely be explained by the compound effect of the secondary radiation from chamber walls and gas only. The constancy, in particular, of the ionisation at pressures exceeding 100-

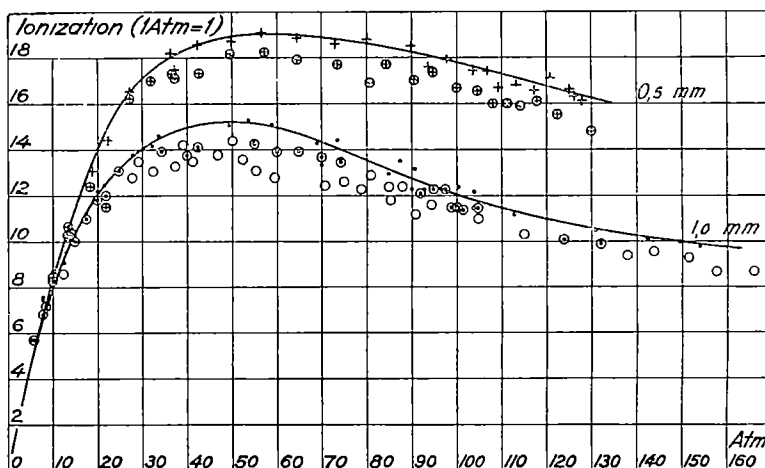


FIG. 2—Ionisation-pressure curves for X-radiation

120 atm with  $\gamma$ -radiation cannot be explained in this way. Tarrant (l.c.) has recently obtained similar results with  $\gamma$ -rays from thorium-C'', which also seems to confirm this view.

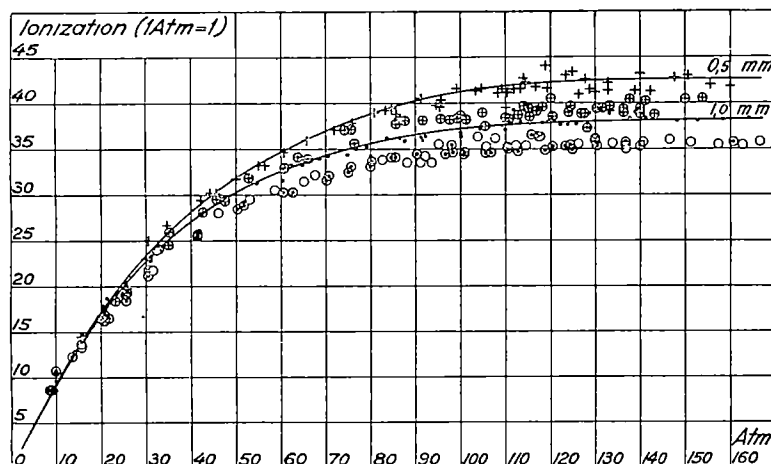


FIG. 1—Ionisation-pressure curves for  $\gamma$ -radiation

consequently 0.5/130) was by chance approximately the same as that between the mean range of the secondary rays emanating from the chamber walls, which might explain the agreement. Further measurements with electrode distances of 1.0 mm and 2.0 mm, however, gave practically the same curves. In the experiments the field strength varied between

The curves in Fig. 2 were obtained with X-rays for air. Here again the fall in ionisation that is noticeable at high pressures can scarcely be due exclusively to current being below saturation value.

On both curves (Figs. 1 and 2) the points marked by circles were obtained when a reduced electrode voltage difference ( $< \frac{1}{2}$ ) was used.

Possibly the results may be explained by initial recombination of the ions. The probability that an electron after emission will be deflected by the surrounding molecules, in such a manner as to be recombined with the corresponding positive ion, will probably increase rapidly with the gas pressure at high pressures. With softer radiation this effect must be noticeable even at lower pressures. It is also probable that the absolute saturation current cannot be obtained at

high gas pressures, and that as the pressure increases, the current-voltage curves show continuous change over to those prevailing in certain fluids (cf. Jaffé,<sup>5</sup> Stahel<sup>6</sup>).

The results agree well with the similar explanation given by Compton, Bennet, and Stearns<sup>7</sup> in a paper discussing the curve obtained by Broxon.



The investigations are being continued with different gases and different wall materials

R M SIEVERT

Physical Laboratory of the  
'Radiumhemmet',  
Stockholm, March 15

- <sup>1</sup> J W Broxon, *Phys Rev*, 37, 1320, 1931  
<sup>2</sup> G T P Tarrant, *Proc Roy Soc A*, 135, 223, 1932  
<sup>3</sup> E G Steinke and H Schindler, *Naturwiss*, 20, 15, 1932  
<sup>4</sup> R M Sievert, *Acta Radiol*, 12, 190, 1931  
<sup>5</sup> G Jaffé, *Ann Phys*, 25, 257, 1908 and 42, 303, 1913  
<sup>6</sup> E Stahel, *Strahlenther*, 31, 582, 1929  
<sup>7</sup> A H Compton, R D Bennet, and J C Stearns, *Phys Rev*, 38, 1565, 1931

### Heterospory and the Angiosperms

FOR many years it has been generally assumed by botanists that in Angiosperms, as in the heterosporous Pteridophytes, the megaspores are larger than the microspores. In a study of megaspore development in *Oenothera rubricalyx* (Gates and Sheffield),<sup>1</sup> it was incidentally discovered that this is not the case. Series of measurements showed that the corresponding absolute values were about  $4930\mu^3$  for the 'megaspore' mother-cell and  $12,630\mu^3$  for the 'microspore' mother-cell at the end of meiosis. The need for comparative measurements of the size of the spores in the pollen and ovules of various plants was pointed out, and brief reference was made to the possible significance of the above condition.

It has since been found that this subject has been independently discussed at some length by Prof R B Thomson,<sup>2</sup> who has also made measurements of spore size in various Pteridophytes, Gymnosperms, and Angiosperms. He finds that in some Cycads, Conifers, and Angiosperms the pollen spore is larger than the seed spore, while in others the reverse is the case.

There is then at present no certainty that the Angiosperms were derived from heterosporous ancestors. That the microspores are larger than the megaspores in *Oenothera*, *Pontederia*, and *Typha*, while they are smaller in *Lilium*, may be a local development in each case. It is to be expected that the morphological and biological relations within the flower, such as size of ovule and length of style, will be factors in adjusting the relative size of the spores which produce respectively the male and female gametophyte. Thus in *Oenothera* the need for a long pollen tube necessitates storage of food material in the pollen mother-cell. This is abundantly present in the cytoplasm and helps to account for the large size of the cell. In the ovule, on the other hand, food storage occurs not in the megaspore mother-cell but especially in the chalazal region of the nucellus.

Thomson proposed the term heterangy for the condition in seed plants where the megaspore is retained within the megasporangium (ovule), confining the term heterospory to those forms in which the megaspores are discharged. Thus the ancestor from which seed-plants (Pteridosperms) arose might have been heterosporous in the sense in which the term is used in *Selaginella* and other Pteridophytes, or it might equally well have been homosporous but heterangious. *Equisetum* well represents an earlier condition, homosporous, homangious, with the gametophytes developing externally to the spores. From such a condition, seed plants showing heterangy and an intrasporal female gametophyte might have developed.

It is well known that although *Equisetum* is homosporous, some of the spores produce a male gametophyte and some a female. The latter may, however, sometimes develop antheridia as well as archegonia, although it does not appear to be known whether the

male gametophyte ever produces archegonia. The fact that the female gametophyte may produce both types of sex organs indicates that the separation of sex tendencies in meiosis in *Equisetum* is not absolute. Hence it would probably be futile to look here for sex chromosomes. Nevertheless, it may be that nuclear differentiation is responsible for the fact that some spores of *Equisetum* produce a male and some a female gametophyte. It needs to be definitely determined whether two spores of each tetrad are male and two female in tendency. If this were so, the differentiation might have resulted from an endosporal chromosome mechanism for sex determination similar in its main features to that which is known in certain Liverworts and in certain dioecious flowering plants, but less fully developed.

It may be pointed out that such a nuclear differentiation of homospores would involve an evolutionary process of quite a different nature from that which has given rise to the differentiated megasporangia and microsporangia of *Selaginella*. It is difficult to see how these two processes could have taken place even successively in the same series of organisms. Thus the heterospory in *Selaginella* could not have been superposed upon the condition found in *Equisetum* if the latter is a case of morphological homospority but with the spores of each tetrad separated as to sex. On the other hand, if the separation of spore types in *Equisetum* is only a partial one, environmentally controlled, it may have been brought about by the same kind of evolutionary process as has produced the differentiation of microspores and megaspores in *Selaginella*.

The differentiation, in the same cone, of microsporangia and megasporangia containing spores which develop their respective gametophytes, as in *Selaginella*, is a somatic differentiation which is completely independent of the meiotic divisions. It could not have been preceded by spore differentiation of a type in which the sex potentialities of the spores in each tetrad are separated. How the condition in *Equisetum* was derived in turn from that in the homosporous leptosporangiate ferns, in which each spore produces a gametophyte bearing both male and female sex organs, we do not know.

Thus it appears that the ancestral seed plants were derived from forms which developed heterangy, but not from homosporous forms with sex potentialities separated in meiosis. Whether they had megaspores and microspores seems quite uncertain. Perhaps descendants of the modern eusporangiate ferns might lay claim to represent such a group. Since, however, the relative sizes of the male and female spores in different families of Angiosperms can vary so widely, there seems no adequate reason at present for denying that the group may have been derived from ancestors which showed heterospory. The sporangium is so closely related to its enclosed spores that differentiation of sporangia as an evolutionary process must be closely connected with differentiation of spores. This means heterospory in the etymological sense, although not necessarily in the sense in which that term is commonly used.

A large and interesting field regarding the relative sizes of the spores in Angiosperms, their evolutionary relationships, and their relations to various features in the biology of the species, here awaits investigation.

R. RUGGLES GATES

King's College,  
University of London,  
April 17.

<sup>1</sup> Gates and Sheffield, "Megaspore Development in *Oenothera rubricalyx*", *Proc Roy Soc B*, 105, 499, 1929.

<sup>2</sup> Thomson, R. B., "Evolution of the Seed Habit in Plants", *Trans Roy Soc Can*, 21, 229, 1927.

## Atomic Weight of Fluorine

WE have recently pointed out<sup>1</sup> that there appears to be no evidence for the view expressed by Prof Moles that methyl fluoride made by Collie's method consists of a constant boiling mixture with methane. It was, however, suggested by Prof Moles that both Collie's critical data and also the compressibility at 0° C (1.011) which we deduced from microbalance measurements are incorrect owing to the above cause. We have accordingly carried out a series of determinations of the critical constants of methyl fluoride prepared both by Collie's method and also by the methyl sulphate-potassium fluoride method used by Prof Moles. We have also measured the compressibility coefficient of methyl fluoride made by the latter method.

The methyl fluoride prepared by Collie's method was that used in our preliminary determinations of the limiting density. The gas generated by the second method appeared to be mixed with rather more than its own volume of methyl ether. The material thus obtained was purified chemically and also by repeated fractionation, the final sample being bubbled through its own liquid. It must be emphasised that whereas it is comparatively easy to obtain pure methyl fluoride by Collie's method, we found it exceedingly difficult to purify the gas obtained by the methyl sulphate method.

The critical data of the two samples of the gas were determined in a modified Andrews compression apparatus. The critical temperatures and pressures were identical for the two samples, whilst the critical volumes agreed within the limit of error of our measurements. This agreement of the results appears to indicate that pure methyl fluoride can be obtained by either method. The critical constants also show no great divergence from those originally determined by Collie. A comparison of the data is given in the accompanying table.

| Observer             | Critical Temp | Critical Press   | Critical Vol     |
|----------------------|---------------|------------------|------------------|
| Collie               | 44.9° C       | 62 atmos         | —                |
| Cawood and Patterson | 44.55° C      | 58.0 ± 0.2 atmos | 3.33 c.c. per gm |

The *pv*-*p* isothermals of methyl fluoride made by the methyl sulphate method were measured in the compression apparatus over pressures of 1 to 3 metres using tubes of 4.5 mm bore. The relationship between *pv* and *p* was linear to a considerable degree of accuracy, and gave at 0° C for the compressibility (1+ $\lambda$ ) over 1 atmosphere the value 1.0115. This result is in satisfactory agreement with the figure 1.011 which we calculated for the compressibility at 0° C from our microbalance experiments at 21° C, and also with the calculations of van Laar when allowance is made for the changes in the critical data. This figure is, however, entirely different from the value 1.018 measured by Moles and Batuecas<sup>2</sup> and used by them in their determination of the limiting density of methyl fluoride. If the compressibility 1.0115 is applied to their normal density a value of 19.2 is obtained for the atomic weight of fluorine. There appears, therefore, to be little doubt that their determinations, both of the normal density as well as of the compressibility of methyl fluoride, are incorrect, though by a partial compensation of errors they lead to an atomic weight of fluorine in accordance with the mass spectrograph measurements.

We have also measured the compressibility of methyl fluoride at 21° C, and find the value 1.0087. This is in satisfactory agreement with our microbalance value of 1.0083, when it is considered that the latter determination was only made over a pressure range of about 170 mm. It will be noted that if we apply the

correct value 1.0087 to our microbalance ratios previously given,<sup>3</sup> the atomic weight of fluorine still remains at the value 19.01.

The details of these investigations will be published elsewhere.

H. S. PATTERSON  
W. CAWOOD

The University,  
Leeds, April 26

<sup>1</sup> NATURE, 129, 245, Feb. 13, 1932.

<sup>2</sup> J. Chem. Phys., 18, p. 353, 1920.

<sup>3</sup> NATURE, 128, 375, Aug. 29, 1931.

## Ovis astore, a Three-Coated Sheep

INTERESTING speculations have been made in these columns recently on the constitution of the coat of a sheep from Astor (Gilgit) which was first described by Prof Barker<sup>1</sup>.

An examination of the cuticular scale structure of the component fibres of the fleece would afford real evidence as to whether or not such fibres would fall readily into three distinct groups. I therefore obtained, by courtesy of Prof Barker, a sample of the fleece of the sheep from Astor, compared the appearance and lengths of the various fibres, and made a careful examination of the whole of their scale pattern. The scaling of the cuticle was seen by using a method which demonstrates faithfully the scale margins even of densely pigmented fibres.

During a general examination of the sample, I found, in addition to the three classes of fibres

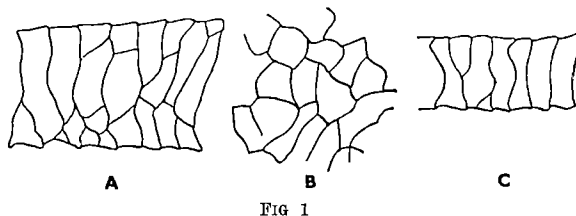


FIG. 1

previously described, namely, long coarse white, short fine white, and short coarse pigmented, two other classes of fibres, these were (a) a long, coarse, and slightly pigmented fibre, (b) a long, curly white fibre intermediate in diameter between the long coarse white fibre and the short fine white wool fibre. It remained to compare the scaling of these five kinds of fibres, and the following results emerged.

I *Heavily pigmented fibres of various lengths* (2.5-5.5 cm). These fibres all showed an irregular segmental mosaic pattern (Fig. 1, A) almost as far as the tip end.

II *Long (6-7 cm) slightly pigmented fibres*. These fibres showed a generalised mosaic pattern (Fig. 1, B) which merged into the irregular segmental mosaic (vide Fig. 1, A) type of scaling, often in the upper portion of the fibre.

III *Long (8-9 cm) coarse white fibres*. This fibre exhibits the generalised mosaic pattern (vide Fig. 1, B) along most of its length, but the irregular segmental mosaic pattern is seen in some portions.

IV *Long (6-7 cm) curly white fibres*, intermediate in diameter between those of III and V (vide infra). The scaling was definitely of a mosaic, and mostly of an irregular segmental mosaic character.

V *Short (1-2 cm) fine curly white wool fibres*. The scales of these fibres were shallow and mostly coronal, that is, each scale generally completely encircled the fibre (Fig. 1, C).

The sample had been cut from the sheep and consequently the scaling of the extreme roots and tips

of fibres could not be observed. From the data given above, however, the following points emerge

- (1) The heavily pigmented fibres (I) vary considerably in length
- (2) The irregular segmental mosaic pattern of the scales of the heavily pigmented fibres (I) is also seen in portions of the long coarse white fibres (III)
- (3) There occurs in the sample a fibre (II) which shows both generalised and irregular segmental mosaic scaling, and in addition is intermediate even so far as pigmentation is concerned, between the fibres under the headings I and III
- (4) A long white fibre is present, intermediate in general appearance between the fine short wool fibre (V) and the coarse white fibre (I), and showing the two mosaic types of scaling

The approximation, therefore, of the scale pattern and other features of all these classes of fibres, suggests that their separation into three constitutional fibre types is hardly possible on the data available. An accurate conception of the constitution of the coat of this sheep can scarcely be gained until further observations are made over a considerable period on the growth and shedding of its constituent fibres

A B WILDMAN

Zoology Department, University,  
Leeds, April 19

<sup>1</sup> NATURE, 129, 128, Jan 23, 1932, 129, 436, March 19, 1932

#### Senile Degeneration in Plants

THE question of the 'wearing out' of varieties of cultivated plants that are propagated asexually is a subject of recurring discussion, one of the latest contributions being a paper by Bijhouwer<sup>1</sup>

The classical example is that afforded by the continual replacement of varieties of potatoes by newer varieties, which in their turn seem to lose vigour and disappear from cultivation. But this may be explicable by the tendency of potato stocks to accumulate 'virus' diseases, which will eventually reduce the cropping power of the variety by one-half. Again, the Ribston Pippin apple is often quoted as a variety that has become so liable to canker that it can only profitably be grown on the most favoured soils. But there is evidence that from the time of its general distribution, about a hundred and fifty years ago, Ribston Pippin has been a bad 'doer', retained on account of the outstanding quality of its fruit. So the argument runs on, one school maintaining that varieties not regenerated from seed grow old, while the other argues that the evidence points either to the accumulation of disease or to practical displacement by the introduction of improved varieties. The purpose of this note is merely to direct attention to a most remarkable example, which seems to have escaped notice, of age in a clone only propagated vegetatively.

The saffron crocus (*Crocus sativus* Linn.) has been cultivated on a large scale for a very long time. It is still grown in Spain, Italy, and the Mediterranean countries to yield commercial saffron (the dried stigmas of the flower). It was grown as a crop in the sixteenth and seventeenth centuries between Saffron Walden and Cambridge (*vide* a paper presented by the Hon Charles Howard to the Royal Society in 1678)<sup>2</sup>. Yet the saffron crocus of cultivation is a sterile clone, increasing only by the numerous small offset corms it produces. No wild habitat is known, and though there are several closely related forms from Greece and the Levant which are fertile, none is identical with the true saffron crocus. Its sterility is

reported by all the old writers and is now explicable by its irregular chromosome constitution. But the exceptional feature is the antiquity of the records we possess of the saffron crocus. Not only was saffron as dye and drug familiar to the Greeks, but also in the Temple of Minos, in Crete, Sir Arthur Evans disclosed a beautiful fresco representing a man gathering saffron, the identity of the flowers being unmistakable because of the highly coloured protruding stigmas. The fresco is reproduced in colours in Sir Arthur Evans's "The Temple of Minos", vol 1, p 265. The fresco belongs to the Middle Minoan period, c 1900-1800 B.C., thus giving a recorded history for this clone of more than 3700 years.

A D HALL

The John Innes Horticultural Institution,  
London, S W 19,  
May 5

<sup>1</sup> Abbreviated version, *J. Pomology*, 9, 122, 1931

<sup>2</sup> *Phil. Trans.*, 12, 945, 1678

#### Feeding Experiments with Methionine

WE have, for some time, been interested in the metabolism of methionine, for which one of us (T. E. W.) has, with Prof. G. Barger, devised a new synthesis<sup>1</sup>. An attempt to find the effect of methionine on growth of rats was actually in progress when R. W. Jackson and R. J. Block<sup>2</sup> announced that methionine, added to a cystine-deficient diet, produced extra growth as compared with controls. As, however, these workers have not yet published figures or experimental details, we consider it worth while reporting our results which confirm their announcement.

The diet we used was that of Sherman and Merrill<sup>3</sup> (using marmite and cod liver oil as sources of vitamins), of which a sufficient supply was mixed in one batch for the whole experiment. To a quarter of this, *l*-cystine was added (2 gm per kilo) and thoroughly mixed in, while to a second quarter *d*-*l*-methionine (2.5 gm per kilo) was similarly added, and the remainder kept for control.

During the control period, which all animals underwent, we adjusted the amount of food supplied so that it was all consumed, but was near the limit of the animals' appetite. Thereafter, both during the remainder of the control period, when only weight measurements were being made, and after transference to cystine or methionine containing diets, this amount of food (8 gm) was supplied to each rat.

The average increase in weight per rat over a period of 25 days was as follows: controls, 16.0 gm; cystine, 27.0 gm; methionine, 22.5 gm. During the preceding control period of 25 days the three groups increased by 12.5 gm, 12.1 gm, and 13.6 gm per rat respectively.

It appears that *d*-*l*-methionine, added to the Sherman-Merrill diet, can produce increased growth in rats, and in this respect it is almost as efficient as cystine. It is curious to find two substances of such different chemical structure acting in the same way, and accordingly we have experiments in progress to determine whether cystine and methionine are interchangeable and utilisable for the same purpose, or whether they are both 'essential' amino acids in which the Sherman-Merrill diet is deficient. We are also comparing the effects of dextro- and levo-methionine.

T. E. WEICHELBAUM  
M. B. WEICHELBAUM  
C. P. STEWART

Department of Medical Chemistry,  
University of Edinburgh,  
April 25

<sup>1</sup> G. Barger and T. E. Weichselbaum, *Biochem. J.*, 25, 997, 1931

<sup>2</sup> R. W. Jackson and R. J. Block, *Science*, 74, 414, 1931

<sup>3</sup> H. C. Sherman and R. Merrill, *J. Biol. Chem.*, 63, 331, 1925

### A New Kidney Virus

THE discovery of large acidophil intranuclear bodies in the convoluted tubule cells of the kidneys of London sewer rats<sup>1</sup> has led to the examination of rats from other localities in order to determine the prevalence of these structures. The results of this examination have shown that intranuclear bodies are almost invariably present in London sewer rats, including both *Rattus norvegicus* and *Rattus rattus*, but in rats from other localities have been found only in those which presumably might have lived in sewers or fed on town refuse, and have been absent from rats caught in the country under hay-stacks, or in similar localities. Moreover, with two exceptions, they have never been found in white rats, including both normal individuals and others infected with various diseases, or exposed to the action of kidney irritants, such as uranium nitrate. The two exceptions were rats which had been kept with infected sewer rats and may have acquired the infection from them.

It has been found possible to infect white rats by the inoculation of suspensions of the organs of infected wild rats, but the resulting infections have always been slight, never approaching in intensity those shown by the majority of sewer rats in London.

The prevalence of the infection in the latter suggested the possibility that the virus might be present in the sewage, and accordingly white rats were inoculated repeatedly with Berkefeld filtrates of material from the Tyburn main sewer. At first negative results were obtained, but afterwards the sewage was mixed with 10 per cent nutrient broth before being passed through a Berkefeld N filter. Using this method, I have recently succeeded in producing the development of acidophil intranuclear bodies in the convoluted tubules of white rats inoculated with filtrates, and consequently it is evident that the infection is present in the sewage.

With regard to the origin of the virus, it is of interest that similar intranuclear bodies have occasionally been observed in the routine examination of human post-mortem material, but always under conditions which precluded the possibility of any experimental study of the condition. Moreover, I have found them in the kidneys of various species of monkeys dying in public menageries, in which they are very much more common than in monkeys obtained direct from dealers. Although large numbers of other species of animals have been examined, hitherto these kidney virus bodies have been found only in rats and monkeys, apart from the few records of human cases. It is possible, however, that other species may show similar virus bodies in the kidney cells, and I would welcome the opportunity of examining any human or animal tissues which show any abnormalities in the appearance of the nuclei.

E HINDLE

National Institute for Medical Research,  
London, N W 3, May 9

<sup>1</sup> Hindle, E., and Stevenson, A. C., *Trans Roy Soc Trop Med and Hyg*, 23, 327, 1929

### Fatuoid or False Wild Oats

In a recent communication, Mr E. T. Jones<sup>1</sup> has reported some observations on the genetics of a hybrid (presumably triploid) between the tetraploid *Avena barbata* and the diploid *A. brevis*. He argues that, since in his *barbata-brevis* progenies the 'fatuoid' complex breaks up, and since in the *sativa-fatuoid* crosses it does not do so, Huskins'<sup>2</sup> explanation of the fatuoid phenomenon cannot be upheld. His argument appears, however, to contain two fallacies—one genetical and the other cytological.

In the first place, it is almost impossible to interpret the genetical behaviour of a triploid, and particularly of an allotriploid such as this hybrid. This is due to the extreme irregularity of its cytological behaviour and the complications of selection for balance. Jones has apparently neglected this. Moreover, he has assumed that the grain-apex character is linked with, or forms part of, the fatuoid complex, and similarly with respect to the character for awn type. He has advanced no evidence for this assumption, and his observations of "crossing-over" may be nothing more than the result of random assortment of factors carried on non-homologous chromosomes. It may be noted that no crossing-over between factors of the fatuoid complex has been observed by Surface<sup>3</sup> and Philp (unpublished) in crosses between the hexaploids *A. sativa* and *A. fatua*.

In the second place, Jones assumes that pairing of the B and C chromosomes necessarily involves free crossing-over throughout their length. It has generally been assumed on good grounds, however, that like most differences between species, the fatuoid character is determined by a complex of factors. Such differences are usually associated with differences in alignment of genes or in chromosome structure, and are known to reduce crossing-over in the structural hybrid (see Darlington)<sup>4</sup>. It follows, therefore, that a chromosome carrying the fatuoid factors may pair with a chromosome carrying the normal factors and crossing-over may occur, but *not* within the factors of the fatuoid complex where the chromosomes are structurally differentiated.

We may conclude, therefore, (a) that the *barbata-brevis* cross is not analogous with the ordinary fatuoid case, and genetic crossing-over in the fatuoid complex cannot be considered proved, and (b) although crossing-over in the chromosomes carrying the fatuoid and normal complexes occurs, it does not necessarily involve crossing-over in the complex itself and does not invalidate the Winge-Huskins hypothesis.

J. PHILP

The John Innes Horticultural Institution,  
London, S W 19,  
April 27

<sup>1</sup> Jones, E. T., *NATURE*, 129, 617, April 23, 1932

<sup>2</sup> Huskins, C. L., *J. Genet.*, 18, 315-364, 1927

<sup>3</sup> Surface, F. M., *Genetics*, 1, 252-286, 1916

<sup>4</sup> Darlington, C. D., *Biol. Revs.*, 6, 1-43, 1931

### Retrocerebral Organ of *Sagitta*

THE recent discovery by Mr C. C. John<sup>1</sup> of the entrance of nerve elements into the anterior end of the retrocerebral organ of *Sagitta* is of much interest. In researches carried out by me<sup>2</sup> no such connexion with nerve cells was seen, though it was stated that there might be a connexion with some of the brain cells near the hind end of the organ, where some spindle-shaped bodies had been described. Mr John's discovery makes this supposition rather more improbable.

Notwithstanding the interest with which I read Mr John's paper, I must take exception to his statement that one of the figures in my memoir (Plate VI, Fig. 45) is misleading. In the course of a discussion on certain features of the nervous system, Mr John emphasises the fact that the optic nerve arises from the central 'punktsubstanz' of the brain and passes back ventral to the retrocerebral organ. With reference to my memoir, Mr John says "his diagram of the brain and retrocerebral organ is apparently misleading. According to him, this organ is completely surrounded by nerve cells, and the optic nerve originates from its posterior border." No mention is made of the next figure of the same plate (Fig. 46), giving a vertical section of the brain, in which the optic nerve

is shown quite clearly as having a course similar to that described by Mr John himself, and he apparently makes the statement quoted solely on an inspection of Fig 45

If, however, he had consulted also my explanation of the figures, he would have seen that this particular figure (Fig 45) is described as a composite one. It is quite true that a single horizontal section would not show all the nerves as depicted in this drawing. An origin for the optic nerve such as is ascribed to me by Mr John certainly could not be a "specific variation", to use his own words.

Sections of the head of a number of different species of Chætonotha were examined in the course of the work for the memoir, and it was found that there was remarkably little variation in the cephalic nerves.

Mr John's work on the hood and coelomic cavities shows that there is need for a careful revision of the development of *Sagitta*, and an interesting, though difficult, piece of research awaits one who can devise a method for keeping and breeding this animal in the laboratory in Great Britain.

S T BURFIELD

Zoology Department,  
The University,  
Liverpool, April 1

<sup>1</sup> *Proc Zool Soc*, pt 4, 1907, Dec 1931

<sup>2</sup> *L M B C Memoirs*, 27, *Sagitta*, Oct 1927

### Ciliated Reproductive Bodies in the Cyanophyceæ

A COLLECTION of algæ from a pond near Orpington, Kent, on Feb 6, was found to contain two species of *Oscillatoria* in quantity, among various other forms. The material was cultured in a rather warm laboratory in a large vessel placed near the window, tap-water being added. On Feb 9, a comparatively small, more or less spherical cell was seen to detach itself from the end of one of the filaments of the larger species of *Oscillatoria* (probably *O. limosa* Ag.) and to swim away with the characteristic movement of a ciliated zoospore. The swarmer was blue-green in colour, matching that of the filament but slightly fainter, and showed no definite chromatophore or nucleus. After swimming for some time, it became sluggish in its movements, eventually became stationary, and began to disintegrate about twenty-five minutes after beginning to swim. The next day another similar swarmer was seen to become detached as before. This one was ultimately lost from sight after swimming for about half an hour.

No more cells actually swarming have been observed since, but what are almost certainly stages in the formation of these swarmers have been seen quite frequently in this culture.

The swarmers were naked cells with the pigments apparently mainly or entirely in the peripheral region of the distinctly granular protoplast. It is hoped to publish later a full and illustrated account of this novel method of reproduction.

The presence of swarmers in the Cyanophyceæ has been recorded more than once previously,<sup>1</sup> but none of these records has received universal acceptance. That *Oscillatoria*, a typical cyanophycean genus, may, under certain conditions, produce swarmers, promises to shed an interesting light on the relationships of the class.

JOHN K SPEARING

Botany Department,  
King's College, London,  
April 21

<sup>1</sup> Goebel, *Bot Z*, 38, 490, 1880 in *Merismopedia*, Dangeard, *Le Botaniste*, 1, 160, 1889 in *Glaucocyste*, etc.

### Leaf-Curl of Cotton in Garden Zinnias in North India

IN a note on the leaf-curl of cotton,<sup>1</sup> Mr M A Husan queries the possibility of Aleurodids being responsible for the transmission of this disease, and points out that Aleurodids do not convey it in the Punjab. Since Mr Husan's note was written, Mr Kirkpatrick<sup>2</sup> has definitely proved that the Aleurodid, *Bemisia gossypiperda* of Misra and Lamba, is the vector of leaf-curl of cotton, and recent investigations in Dehra Dun on a virus disease of garden zinnias suggest that it is identical with the leaf-curl of cotton and is transmitted by the same vector. Detailed results will shortly be published. Meanwhile it would seem that the presence of leaf-curl of cotton and its Aleurodid vector in India should be suggestive to those interested in the cotton industry of the country.

R N MATHUR

Branch of Forest Entomology,  
Forest Research Institute and College,  
Dehra Dun, March 7

<sup>1</sup> *NATURE*, 128, 958, Dec 20, 1930

<sup>2</sup> *Bull Ent Res*, 22, pp 323-363, 1931

### Vibrational Specific Heat of Carbon Dioxide

LAST year I reported on measurements of the velocity of high frequency sound in carbon dioxide at room temperature,<sup>1</sup> the results of which—namely, increasing sound velocity with increase of frequencies from 1 to  $6 \times 10^5$  hz—could be interpreted quantitatively by assuming a definite life-period for oscillation quanta and, resulting from it, an imperfect adjustment of thermal equilibrium in the case of quickly altering conditions, which circumstance is observed as an apparent diminution of vibrational specific heat. Recently Eucken, Mucke, Becker,<sup>2</sup>

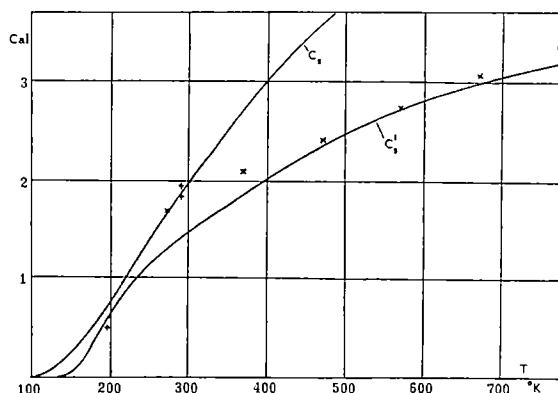


FIG 1

and P S H Henry<sup>3</sup> have interpreted similarly the measurements of the vibrational specific heat of diatomic gases, for, if carried out by means of the Lummer-Pringsheim or the sound velocity method, they obtain almost always results lower than those which according to theory may be expected.

The influence of the limited duration of adjustment upon measurements with low frequency sound at different temperatures may be calculated for carbon dioxide by applying the above theory. It should be noted that (1) the symmetric longitudinal oscillations ( $\nu = 1272 \text{ cm}^{-1}$ ) are difficult to excite and therefore of long life-period, (2) the non-symmetric longitudinal oscillations ( $\nu = 2350 \text{ cm}^{-1}$ ) are of strong optical activity, which means emitting their energy

in the form of radiation, their life-period accordingly being much less, (3) different life-periods are co-ordinated with the 1, 2, etc., state of transversal oscillation ( $v = 673 \text{ cm}^{-1}$ )

In this way, without any new assumption, the dependence on temperature of the apparent vibrational specific heat can be calculated as it should result from measuring the velocity of sound at a frequency of  $3000 \text{ sec}^{-1}$ , and a curve (Fig 1) is thus obtained ( $C'$ ), conforming quite satisfactorily to the experimental data at high temperatures especially.<sup>4</sup> In comparison to the normal course ( $C$ ) of the curve, it diverges at high and low temperatures, and approaches it at room temperature. In this way further valuable consequences may be drawn from the work of Dixon, Campbell, and Parker

In these circumstances, the very different interpretations given by Ibbs and Wakeman<sup>5</sup> may be dispensed with. H O KNESER

Physical Institute,  
University of Marburg,  
March 29

<sup>1</sup> *Ann d Phys*, 11, 761 and 777, 1931

<sup>2</sup> *Nature*, 20, 85, 1932

<sup>3</sup> *Nature*, 129, 200, Feb 6, 1932

<sup>4</sup> Dixon, Campbell, and Parker, *Proc Roy Soc*, 100, 22, 1922, and 105, 212, 1924 unpublished measurements from this institute

<sup>5</sup> *Proc Roy Soc*, A, 134, 636, 1932

### Types of Iridescent Clouds

In the winter of 1930-31, I was measuring the height of the aurora in northern Ontario. On one occasion there had been a well-developed single arc which had remained unusually steady throughout the evening, and I was surprised to see at dawn next morning a light band of cloud stretched in a perfect bow from horizon to horizon, and in what seemed to be the exact position that the aurora had occupied. The cloud was of a yellowish, smoky appearance, and quite unlike the cirrus formation present in other parts of the sky. It faded away about sunrise.

The height of the particular auroral arc was not measured, but it cannot have been less than 70 km, and probably was about 100 km. Of course, daylight precluded height measurement of the actual cloud, but if it was connected with the aurora, and therefore likely to have been about the same distance away, the resemblance in apparent curvature would indicate a similar height.

I have seen mention in early writers of similarity between certain cloud-forms and auroræ, but a connexion is hard to explain.

H S WYNNE-EDWARDS  
3515 University Street,  
Montreal, Quebec, April 21

In his account of Prof Størmer's observations on iridescent clouds, Prof S Chapman refers to their rapid internal motion.<sup>1</sup> It is perhaps worth while to put on record that this was also a characteristic of the luminous night clouds of the midsummer of 1885, two years after the Krakatoa eruption. I was living in London at the time, at a house in the City, and obtained from the roof a clear view of the northern horizon at midnight, doubtless the clearer for the mules of built-up area between. The belt of brilliantly white cloud (not iridescent) lying just above the horizon was in rapid internal movement, after turning away one's eyes for a few seconds the forms of component wisps were found to be quite changed. Considering the immense distance (probably 400 miles), the movement must have been very rapid indeed. It is obvious that, to be visible from London at midnight, these luminous night clouds were much

higher than the iridescent clouds, and their height might well have been 80 km.

According to Prof Størmer's observations, no iridescent clouds were visible for many years after 1892. The same seems to have been the case with luminous night clouds, for at midsummer for several years from 1892 I searched for them in vain from vantage points in Essex. But the midnight sky near the horizon was never so clear as it was in 1885, as seen from the heart of London. T S DYMOND

St Leonards-on-Sea,  
May 11

<sup>1</sup> *Nature*, 129, 497, April 2, 1932

### Musical Sands

THE various theories referred to by "A T W" in the review—"Nature and Man in Arabia"—published in *Nature* of April 30, have been so frequently and thoroughly criticised and tested since the publication of my first paper in 1888, that one would have thought it unnecessary to revive the discussions now. However, I may point out that after having succeeded in producing musical sand artificially, it was admitted by Crookes, and other leading physicists, that I had proved my explanation of the cause of the sounds to be the correct one.

Some writers, who must have overlooked the details of my work, have disposed of the matter by stating that I ascribe the phenomenon to 'friction' between the grains—which scarcely does justice to my theory. Friction only produces noise in unmusical sands.

Technically, the musical sounds are produced through the rhythmic acceleration of vibrations following abrupt frictional retardation. No other theory can account for the remarkable results that can be experimentally demonstrated with these sands. Unless the grains comply with the necessary physical conditions, no amount of friction will produce musical sounds.

It is scarcely correct to say that the late Lord Curzon, who corresponded with me for some time on the subject,<sup>1</sup> "brought together all known sources of information on the subject."

C CARUS-WILSON

<sup>1</sup> *Nature*, 113, 274, Feb 23, 1924

### The Neutron Hypothesis

DR J CHADWICK's explanation<sup>1</sup> of the mysterious beryllium radiation is very attractive to theoretical physicists. Is it not possible to admit that neutrons play also an important rôle in the building of nuclei, the nuclei electrons being *all* packed in  $\alpha$ -particles or neutrons? The lack of a theory of nuclei makes, of course, this assumption rather uncertain, but perhaps it sounds not so improbable if we remember that the nuclei electrons profoundly change their properties when entering into the nuclei, and lose, so to say, their individuality, for example, their spin and magnetic moment.

The chief point of interest is how far the neutrons can be considered as elementary particles (something like protons or electrons). It is easy to calculate the number of  $\alpha$ -particles, protons, and neutrons for a given nucleus, and form in this way an idea about the momentum of nucleus (assuming for the neutron a moment  $\frac{1}{2}$ ). It is curious that beryllium nuclei do not possess free protons but only  $\alpha$ -particles and neutrons. D IWANENKO

Physico-Technical Institute,  
Leningrad, April 21

*Nature*, 129, 312, Feb 27, 1932



## Research Items

**Concepts of Disease**—Primitive concepts of disease have been studied by Dr Forrest E Clements with special reference to their classification, geographical distribution, and relative antiquity (*University of California Publications in American Archaeology and Ethnology*, vol 32, No 2) Disease is attributed by primitive peoples in the main to five causes: sorcery, breaches of taboo, the intrusion of a disease object, intrusion of a spirit, and loss of the soul. As to sorcery, only very general statements can be made until the distribution of various kinds of sorcery has been studied. The idea of human control over Nature by magical means may be a Magdalenian invention, and its connexion with various forms of sickness an adaptation of the idea to coexisting theories of disease. Breach of taboo is the latest of the concepts, and may have originated independently in middle America, in the Arctic region, and in southern Asia. All occurrences of spirit intrusion are historically connected. It had evidently undergone considerable diffusion before the full neolithic of western Asia. True possession is a differentiation of spirit intrusion and occurs widely in the Old World, though absent from among the more primitive peoples. Soul loss traces to a single Old World origin, possibly in Siberia. Its time of origin seems to have been the upper palaeolithic. All occurrences of the disease object intrusion are historically connected, probably tracing back to an Old World palaeolithic origin. The concept assumes its greatest importance in western North America and in Australia.

**Decorative Motives in Celebes**—Dr Walter Hough has recently made a study of the decorative designs of a collection of ethnographic objects from Central Celebes presented to the United States National Museum by Dr W L Abbott. The motives on the varied examples of bark-cloth are entirely new to the Museum. In an analysis of these designs (*Proc US Nat Mus*, vol 79, art 29), he finds that there are three elements or units, circles, diamonds, and pairs of crescentic figures, diverging outwardly from a base. These are used either in conjunction, sometimes in a definite order, or as units of design approaching the geometrical. It was suspected that the design was zoomorphic, but the clue to its meaning was afforded by certain hooks of horn and wood, used for hanging articles in the house, and from horn spoons. The former illustrate all grades from the conventional to the realistic, the latter are the more conventional. From these it is apparent that the bark-cloth designs are highly conventionalised forms of a representation of a female figure standing between the horns of a buffalo. The buffalo is identified as the Indian *Bos gaur*, and not the small animal *B anoa* with slightly curved horns native to the island, while the female figure can be identified as Durga, the consort of Siva. Thus, although it is not possible to assign a date to the development of the buffalo design, it is obvious that it is subsequent to the introduction of the buffalo and the Siva cult. As this buffalo motive is the exclusive design of Central Celebes, a question arises whether it displaced a previous Nature design. There is no trace of any admixture with an anterior decorative art in this collection.

**Turkey Crosses**—The reciprocal crossing of buff turkeys with the bronze or wild coloured race gives remarkably different results, according to Mr Anthony Lowther, writing in "The Feathered World Year Book" for the present year (p 439). A buff cock mated to bronze hens, it seems, sires chicks resembling young pheasants in colour when in the down,

and ultimately assuming plumage of a light bronze, with the markings usual in a bronze bird. But the chicks from a bronze cock mated to buff hens are silver-grey in the down, and when in full plumage show a new departure in turkey colouring, being grey with irregular bars of buff and bronze. The buff race is also remarkable for the precocious and prolific laying of the hens, which start earlier than other hen turkeys, and often lay a hundred or more eggs in the year, such productiveness in any other individual hen turkeys being regarded as an event worthy of record in the poultry press. In these buff birds, which, as Mr. Lowther remarks, are really decidedly darker than buff, the wing-quills are white, and this constitutes the only approach to pied colouring ever seen in the turkey, which, although showing a fairly wide varietal range of coloration, is never patchy-looking, and altogether seems far more like a wild bird than any other kind of poultry, in spite of having been domesticated by American aborigines for an unknown period before its introduction into Europe.

**Helminthes of the Rat**—M A Tubangui (*Phil J Sci*, vol 46, Dec 1931) has recorded the species of parasitic worms and their incidence observed during the examination of 950 rats (*Mus norvegicus*) which had been trapped in various parts of Manila. The trematodes were represented by three species (one new) of *Euparyphium*, the cestodes by the larval form of *Tænia taeniaformis* (commonly known as *Cysticercus fasciolaris*), by a new species of *Railletina*, and by *Hymenolepis diminuta* and *nana*—the latter species being only seldom met with, the nematodes by eight genera, including *Rictularia*, a new species of which is recorded, and the Acanthocephala by a single species of *Moniliformis*. With the exception of the Trematoda and the new species of *Railletina* and *Rictularia*, all of which are apparently restricted to the Philippines, the worms recorded have been reported also from other countries. It is interesting to note that *Trichinella spiralis* was not found in the rats examined.

**Self-sterility and Crossing in Herbage Plants**—The subject of self- and cross-fertility and the flowering habits of various herbage grasses and legumes is extensively set forth in Series H, No 12, from the Welsh Plant Breeding Station, in a set of fourteen papers by R G Stapledon, T J Jenkin, R D Williams, A R Beddows, and R A Silow. The results of previous observations, as well as new data, have been collected with regard to the rye grasses, timothy, fescues, cocksfoot, red and white clover, etc. In all, 64 species of grasses and 28 of legumes have been investigated. The results are too extensive to summarise here. They range from high self-fertility in *Bromus arvensis* to practically complete self-sterility in red clover. Many grasses, mainly those which are cross-pollinated, are found to produce chlorophyll-deficient seedlings. An interesting study is also made of the swollen, bulb-like basal internodes of the tall oat grass, *Arrhenatherum*. Plants from commercial seed were non-bulbous, while indigenous plants nearly all showed some degree of bulbous development. This was found to be largely independent of soil conditions. The extreme types, when crossed, produced an  $F_1$  which was definitely bulbous. In  $F_2$  and  $F_3$  segregation for degrees of bulb development occurred, but nearly all were more or less bulbous.

**Diagnosis of *Fusarium* Species**—In spite of much work having been carried out on the subject, the diagnosis of species of *Fusarium* in culture is still extremely difficult. As an auxiliary means of

identification, G H Coons and M C Strong have described a method (*Michigan Technical Bulletin*, 115) by which the various species can be diagnosed according to their reaction to growth-inhibiting substances. The identity of an unknown species may either be determined directly if it should be one of the number already investigated and described, or its behaviour compared with that of a known culture. The method is based on the observation that species and varieties of *Fusarium* show marked differences in mycelium colour, ability to change the colour of dyes, and type of growth on media containing aniline dyes, such as malachite green or crystal violet. A large number of species and varieties of the fungus obtained from a uniform mass of inoculum, were grown on a synthetic medium containing the chemical in a graded series of concentrations. Petri dish cultures kept at constant temperature under humid conditions were used. On cataloguing the results, the 54 various species tested were found to fall into groups according to their sensitiveness to, or tolerance of, malachite green, their reaction to crystal violet was used for further separations. It has thus been possible to make out a provisional 'key' for diagnostic purposes based on these responses to the dyes. Repetition of the tests after several years gave the same results, and a study of the morphological features and physiological behaviour of sub-cultures showed that during 10-15 years no significant change had occurred. Besides the triphenylmethane dyes which were chiefly employed, acriflavine and copper sulphate were found to be of possible use as a means of diagnosis.

**An Artificial Humus**—The detailed study of the chemical composition of organic matter in soils has brought out the fact that humus consists largely of two chemical complexes, namely, lignin (40-45 per cent) and proteins (30-35 per cent), with smaller quantities of other substances, especially hemicelluloses, and to a less extent fats and waxes. In spite of the high protein content of humus, its nitrogen is not readily available to the growth of the higher plants, and it has accordingly been suggested that the formation of humus complexes involves the chemical interaction of the proteins with carbohydrate. Arguing that a combination of protein with lignin is especially probable, Waksman and Iyer (*J. Washington Acad. Sci.*, 22, 41, 1932) have found that solutions of protein and of lignin in alkali give, on mixing and neutralising, a precipitate which, when dried and tested, undergoes no more bacterial decomposition than 'humic acid' prepared from peat by alkali extraction and subsequent acid precipitation. In the presence of bases, such as calcium, magnesium, and iron, the preparations become still more similar to 'humic acid' in their physical and biochemical properties and particularly in their high base exchange capacity. The authors, therefore, conclude that the complexes they have synthesised can be considered as the humus-nucleus.

**Thermal Properties of Liquids**—Volume 16 of the *Scientific Papers* of the Institute of Physical and Chemical Research, Tokyo, contains a paper by Mr H. Shiba on the isothermal and adiabatic compressibilities, the specific heats and the thermal conductivities of twenty-nine liquids, all determined by means of the same apparatus. The liquid is contained in a 25 c.c. glass bulb provided with a capillary stem, and the observations of compressibility are made by decreasing the pressure in the stem from 70 cm. of mercury above atmospheric to atmospheric and reading the movement of the meniscus by microscope. The immediate increase of volume of the liquid gives the adiabatic, and the ultimate increase the isothermal compressibility after correction for the com-

pressibility of glass and the decrease of temperature due to the adiabatic expansion. The change of volume of the bulb under pressure was eliminated by surrounding it with a mercury-filled bulb at the same pressure, which was placed in a Dewar flask in a water bath. The compressibilities are of the order  $1 \times 10^{-4}$  per atmosphere, and their ratios of the order 1.3, and as a rule both numbers decrease as the molecular weight increases in a homologous series.

**New Microphone and Loud-Speaker**—In radio-phonics transmission, electrical incision of gramophone records and reproduction given by such records, and in other applications of electro-acoustics, including sound films, the clearness and fidelity of the electro-acoustic reproduction are intimately related to the quality of the transmitting microphone and of the reproducing loud-speaker. In vol. 64 (1931) of the *Rendiconti* of the Reale Istituto Lombardo di Scienze e Lettere, Prof. Giulio Guiletti gives a description of an electrodynamic microphone and loud-speaker which are based on the same principle as the electrodynamic pick-up recently devised by him. The active part consists of a flat rectangular coil of many turns. When this coil is displaced, one side of it cuts normally the induction lines of a uniform magnetic field established between the expanded ends of two vertical bar electromagnets excited by direct current. The coil is kept in position by an elastic support, which allows it to move only in a horizontal plane, and is connected with the transmitting membrane of the microphone and with the reproducing device of the loud-speaker. By this means exact correspondence is obtained, in the microphone between the induction e.m.f. generated in the coil and the displacements of the membrane, and in the loud-speaker between the current and the electrodynamic action operating the reproducer. These correspondences are brought out clearly by simultaneous oscillograms obtained by using the loud-speaker as sound transmitter and the microphone as receiver.

**Heavy Isotope of Hydrogen**—A full account of the work which led to the recognition of a hydrogen isotope with mass 2 (see *NATURE*, Jan. 16, p. 101) appears in the *Physical Review* for April 1. The existence of this had already been suspected for several reasons—in particular, from the difference between the two values for the atomic weight of hydrogen found chemically and from the mass-spectrograph. At the same time, it is present in such small amount, and gives such very feeble displaced Balmer lines, that it is doubtful if the photographic record of these would have been considered completely conclusive if their intensity had not been increased as a result of the fractionation of liquid hydrogen which was carried out, and was expected, on thermodynamical grounds, to increase the concentration of the heavy atoms. It is now stated that the displaced lines are narrower than those of  $H^2$ . No evidence has yet been found from the spectrum that there is an isotope  $H^3$ , but both this and a heavy helium isotope  $He^5$  might be expected to occur from the course of the graph obtained when the number of protons in the nuclei of the elements is plotted against the number of electrons. The work is being continued with an improved fractionating column, but the opinion is expressed that some process of diffusion may have to be used for the final concentrating. Meanwhile, an examination of the enriched hydrogen has been made by W. Bleakney with a mass-spectrograph, which confirms the results of the optical investigation.

**Time Factor in Telephone Transmission**—Until quite recently, the telephone engineer could assume for all practical purposes that speech was transmitted

instantaneously between the ends of telephone circuits, and so he did not need to complicate his problems by taking the time of transmission into account. The introduction of long range telephony and the use of loaded cables have made it necessary to take the time of transmission into account and made the technical problems much more difficult. O. B. Blackwell has now given data of the approximate speed at which signals are transmitted for various kinds of circuit (*Bell Lab Rec*, Jan). When the loading coils (inductance) of the cable circuit are numerous, the speed is about 10,000 miles a second. At a lighter loading the speed is 20,000 miles a second. With unloaded circuits it may be about 180,000 miles a second, and over radio communication circuits it is taken as the velocity of light, namely, 186,000 miles a second. Telephone engineers have found it possible to talk fairly satisfactorily over circuits with time delays as great as 0.7 of a second, but for commercial service a delay of only about a third of that amount is recommended. Another direct effect of the time of transmission on telephone conversation is the distortion of the speech waves due to unequal velocities for different frequencies of the speech components. Still another result of the appreciable times of transmission is the production of echoes caused by the reflection of the electrical energy at points of discontinuity in the circuit. Some of these waves return to the receiver of the talker's telephone and some to the listener's telephone, causing in each case an echo to follow the transmission.

**Conductivity Equation**—The theory of Debye and Huckel as modified by Onsager gives close agreement with the experimental results for the effect of concentration on electrical conductivity at very low con-

centrations, but not for higher concentrations, and must be regarded as a limiting law. It may be written, for a uni-univalent electrolyte, in the form

$$\Lambda = \Lambda_0 - (\alpha\Lambda_0 + \beta)\sqrt{c},$$

where  $\Lambda$ ,  $\Lambda_0$  are the equivalent conductivities at concentration  $c$  and zero concentration respectively, and  $\alpha$  and  $\beta$  are constants for a particular solvent and temperature. This may be written as

$$\Lambda_0 = (\Lambda + \beta\sqrt{c})/(1 - \alpha\sqrt{c})$$

Shedlovsky (*J. Amer. Chem. Soc.*, April 1932) now shows that very good agreement at finite concentrations can be obtained if an empirical term  $Bc$  be subtracted from the second equation,  $B$  being a constant equal to the slope of the plot of  $\Lambda_0$  calculated from the Onsager equation against  $c$ . For many electrolytes  $B$  is very nearly equal to  $\alpha\Lambda_0 + \beta$ . The new equation has the advantage, as compared with other empirical conductivity equations, that it reduces to the Onsager theoretical equation at zero concentration. It holds up to about decinormal in aqueous solutions. The same author, in a second paper, gives new experimental results for the conductivities of sodium, lithium, and potassium chlorides, hydrochloric acid, and potassium and silver nitrates, in the concentration range 0.00003–0.1 normal. These agree with the equation described, except the results with the nitrates, which may exhibit ionic association. In a third paper, in collaboration with MacInnes, he gives measurements of the conductivities of acetic acid and sodium acetate, from which the thermodynamic ionisation constant of the acid at 25° is calculated to be  $1.793 \times 10^{-5}$ , in fair agreement with the values found by Harned and Owen in 1930, and by Harned and Ehlers in the same journal (April 1932), from electromotive force measurements, namely,  $1.754 \times 10^{-5}$ .

### Astronomical Topics

**Astronomical Notes for June**—Venus is nearing the end of its apparition as an evening star, which has been a very favourable one for northern observers. At the beginning of June, one-fifth of the disc is illuminated, this narrows until June 29, when inferior conjunction is reached. Venus is stationary on June 7, and then rapidly approaches the sun.

Jupiter is rather low in the west, but is still observable in the evening. Saturn is observable after midnight, but its south declination of 19° makes observation difficult.

The sun passes the solstice at 3h 25m P.M. on June 21, and summer begins then. Two stars of magnitude 5.2 are occulted by the moon,  $\tau$  Leonis disappears at 9h 22m P.M. on June 11, and 49 Virginis at 8h 47m P.M. on June 13, the times for five fainter stars are given in the "Nautical Almanac".

Three comets, Houghton-Ensor, Carrasco, and Grigg-Skjellerup, are under observation, all are rather faint. Ephemerides for June are given in the May issue of the *Observatory* and in *B. A. A. Journal* No. 7. The R.A. of Grigg-Skjellerup will be about 7 minutes of time less than the ephemeris value, and the declination about 1½° south of it, these large corrections arise from the comet's proximity to the earth, distance on June 7 about 22 million miles.

Add one hour to all times given to express them in Summer Time.

**Nearest Planet to the Earth**—Prof. E. Bianchi obtained an observation of the Reimmuth planet at Milan Observatory as follows

|                          |               |              |      |
|--------------------------|---------------|--------------|------|
|                          | R.A. (1932 0) | S. Decl.     | Mag. |
| May 12d 20h 57m 15s U.T. | 10h 19m 16s   | 9° 10' 48" S | 12.5 |

The distance from the earth was 6.7 millions of miles, according to Dr. Stracke's latest elements. This is

likely to hold the record for many years as the least distance from the earth at which a planet has been observed. Closer approaches of this planet to the earth are, however, possible, the least distance between the orbits being only two million miles. If Stracke's period of 1.639445 years could be taken as exact, there would be an approach at minimum distance in November 1940, but the arc of observation is much too short to make an accurate prediction so far ahead.

The planet would be about nine million miles from the earth at the time of its transits over the sun. It is so small that it is doubtful whether even the largest telescopes would enable it to be seen in transit.

**The Corona in the Eclipse of October 1930**—A Science Service *Bulletin* of April 23 contains an account of a paper read by Prof. S. A. Mitchell before a meeting of the American Philosophical Society at Philadelphia. He gave an account of the results obtained by the expedition to Niuafoou, or "Tin Can Island". A surprising feature was that the corona resembled the type of sunspot minimum, though the minimum is not expected until 1934, he concluded that the coronal minimum type antedated the spot minimum. Dr. W. J. S. Lockyer had announced a similar conclusion in a paper read before the Royal Astronomical Society, but he did not find such a large discordance between the minima, expecting to find the coronal minimum type in the 1932 eclipse. The *Bulletin* also alludes to the spectroscopic results obtained, though these are not given in detail, it is stated that there were formerly some forty lines in the coronal spectrum of which the origin was unknown, but that the results obtained in 1930 left only eighteen lines of unknown origin.

## The Raman Effect and Chemical Structure

IN the May number of *Scientia*, Prof K W F Kohlrausch discusses at some length the significance of the so-called Raman optical effect. The outstanding importance of this phenomenon, which had been foreshadowed by Smekal from theoretical considerations some four and a half years before its actual discovery early in 1928 by Raman, is evident from the unusually large number of publications which have appeared upon the subject.

Experiment has shown that, whereas the valency electrons are stimulated only by high frequency waves, inter-atomic vibrations can be produced by low-frequency radiation, and of the various ways in which such inter-atomic vibrations can be excited, that due to Raman is by far the easiest to carry out experimentally. The apparatus required is the ordinary spectrophotographic outfit. The substances to be investigated, preferably colourless solids or liquids, are intensely illuminated with discontinuous light such as that emitted by a quartz mercury vapour lamp, and the horizontally scattered light is then photographed spectrographically, when, in addition to the usual characteristic lines of the spectrum, weaker satellites are found, the distances of which from the standard lines are a measure of the frequencies of the inter-atomic vibrations. Now, if reasonable assumptions can be made about the forces which are involved, it is clear that most valuable deductions may be drawn about the molecular structure.

It must be remembered, however, that the method has serious limitations, for in many cases the intensity of the lines becomes vanishingly small. Thus comparison of the results with those obtained by the older method of measuring infra-red absorption bands should be carried out wherever possible as controls, since the two methods of investigation are complementary.

The investigation of molecular structure is by no means simple, although some progress has been made. The simplest case is that of the diatomic molecule, since only one kind of vibration is possible and the

Raman spectrum consists of a single line, apart from any lines due to rotation of the molecule and having frequencies of a different order of magnitude. Further, it is recognised that certain uni- or multivalent radicals can be regarded as single atoms for the purpose of calculation. These radicals possess characteristic 'inner' vibrations, which are independent of the 'outer' vibrations of whole radicals within the molecule. Such 'inner' frequencies are in fact constitutive factors and can be determined quantitatively. Thus it is possible to calculate the value of the 'mean restoring force'  $K$  between two carbon atoms which are united by single, double, or triple bonds. Since the values obtained for  $K$  are approximately in the ratio 1 : 2 : 3, it appears that these old-fashioned valency 'bonds' have some mathematical justification, although it is necessary to bear in mind that other factors might influence the attractive force between the atoms. Molecules consisting of more than two atoms or radicals are more difficult to deal with, but even here some progress has been made by grouping some of the atoms into radicals, and also by taking advantage of the fact that the spatial arrangement can often be determined by purely chemical methods.

The usefulness of the method may be illustrated by its application to the much-disputed case of nitric acid and of other isodynamic molecules, such as prussic acid, acetoacetic ester, etc. In the case of nitric acid, the evidence points to the fact that in the anhydrous condition the structure is exclusively  $\text{HO}-\text{NO}_2$ , whereas on the addition of water, some of the molecules undergo change, since the characteristic spectrum of the anion  $\text{NO}_3$  can be detected. Thus the number, position, intensity, and polarisation of the lines in the Raman spectra are determined not only by the spatial arrangement of the atoms within the molecule, but also by the attractive forces between them, and the complete interpretation of these spectra will facilitate a quantitative knowledge of molecular structure, such as has never before been possible.

## Association of Teachers in Technical Institutions

### ANNUAL CONFERENCE

"WE can leave to those who seek them the somewhat Pyrrhic victories over ignorance of a purely academic education with its exaggerated claims to culture, whilst the general body of mankind proceeds to enjoy the conquests won by technical efficiency in producing the necessities of life." That might be said to be the keynote of the first part of the presidential address delivered by Mr S H Moorfield to the Annual Conference of the Association of Teachers in Technical Institutions held in Cardiff during Whitsuntide. Clearly and forcibly he urged the claims of technical education to a foremost position in the educational systems of mankind in what is obviously a rapidly changing world.

In spite of the fact that Hero described the steam turbine about 200 B.C., that Archimedes was credited with the invention of the screw, that Torricelli taught us much of the mechanics of fluids, that Francis Bacon experimented upon the preservation of food by freezing, and that James Watt definitely applied scientific principles to the improvement of the steam engine, technical education as we know it is but some eighty years old. During that period, human achieve-

ment has been amazing. Transport has undergone transformation which may be well called revolutionary. Electricity has been brought to the service of every department of life, and has brought speed, cleanliness, and convenience in its train. Fifty years ago there was no electric motor in industry. Wireless telegraphy and telephony in their present form and with their world-wide range were undreamt of, electric lighting and heating were nothing more than laboratory experiments. Experts in every sphere of life may now catalogue long lists of conquests. In the presence of these vast changes, it is illogical to maintain that the education of mankind should follow the same course that it has followed for centuries. New environment needs a fresh adaptation of the equipment which enables life to be efficiently sustained.

All this is true. Yet, while lip service is paid to the need for a change in educational policy, there remains much to be done "to combat the influence of reactionaries" who still wield so great an influence. "We find them in posts of educational administration, usually products of the older universities, still living

with their feet upon the solid earth of the twentieth century, but with their heads in the mists of the middle ages." As to the old reply that education must be 'liberal', Mr Moorfield was very clear. "Whilst we do not scorn to provide instruction in matters relating to the manual dexterity of the artizan, we emphasise the necessity for the deeper understanding which is provided in a complete technical course designed to meet the needs of those engaged in particular occupations. Such a course is a continuation of a liberal education and cannot in any sense be narrow. Contacts with other occupations are constantly being made, and the engineer begins to understand the miner and the miner the engineer, and the builder will make the acquaintance of both." "We stand for that kind of education which will enable human beings so completely to understand the forces of Nature that the fear of these things, which, in the past, has bred devil-worship, witchcraft, and superstitions in general, may be banished from their lives and cease to burden them with oppression." Further, technical education is "the very spearhead of the attack upon drudgery and want, the fundamental causes of such a large proportion of human unhappiness."

Modern civilisation, however, involves something more than the development of engineering and chemistry and all those departments which come so easily under a scientific heading. They all aim at the successful production which technical efficiency can give. But technical efficiency towards production is not enough. If products be not adequately distributed, their value disappears, and it is in distribution that we find our most pressing problems. Upon the edifice of scientific production we have to impose an equally scientific scheme of distribution. At present the latter is chaotic, and the commercial sides of our great technical institutions are developing schemes of education to remedy the defect. The recent crisis brought to the forefront problems which seem to be baffling even to the expert. There are gluts of wheat, rubber, coffee, tea, iron, copper, tin, and even diamonds. Gold lies uselessly

hoarded in the coffers of two or three of the great nations of the earth. "With plenty in the world, men suffer privation and want." It was in this connexion that Mr Moorfield called for closer liaison between commercial teachers and the general body of technical teachers. Already their function has been laid down in no narrow sense by the Committee on Education for Salesmanship. "Salesmanship as we understand it is a prime function of direction and supreme management. It embraces the study of the fundamental principles of commerce—it is therefore education for commerce on its creative, organising, and executive sides."

Among the resolutions dealt with by the Conference was one urging the closer co-operation of education and industry by means of the formation of a national co-ordinating committee composed of representatives of industry, commerce, educational administration, and technical teachers. Such a committee would be invaluable as a clearing-house for ideas and proposals made by similarly constituted committees which have been formed to act regionally. Another resolution urged the remission of part of the period of apprenticeship for pupils who have followed a full-time course in a technical institution, the extension of opportunity for all entrants into industry to become skilled workers, and the provision of part-time day courses for apprentices and other adolescent workers.

The Conference was officially welcomed by the Lord Mayor of Cardiff and Councillor J Hellyer, deputy chairman of the Education Committee. An exhibition of books and apparatus was held in the Cardiff Technical College. At the annual dinner of the Association on Whit Monday, Prof. George Knox, who has done so much for mining education in South Wales, directed attention to the essentials to industrial success. In addition to capital, raw material, and machinery, suitable personnel to advise upon, organise, and manage these essentials is an absolute necessity. How far, he asked pertinently, has the lack of attention to this matter of personnel contributed to the present position of secondary industries in the South Wales area?

### White Dwarf Stars

THE Halley Lecture delivered at the University of Oxford by Prof. E. A. Milne on May 19 was on the subject of the "White Dwarf Stars." He said that the discovery by Halley of the proper motion of some of the fixed stars led to a remarkable succession of researches in pure astronomy, in modern physics, and in cosmogony generally. The proper motion of one of Halley's stars, Sirius, was found by Bessel not to be uniform, but to contain a periodic element of about fifty years. This led him to suggest that Sirius was in reality double, consisting of a pair of stars, one much fainter than the other. In 1862 a faint star, Sirius B, was actually seen by Alvan Clark close to the place that had been theoretically assigned to the supposed companion. In 1915, W. S. Adams at Mount Wilson Observatory succeeded in obtaining a photograph of the spectrum of Sirius B, which led to the unexpected conclusion that the density of Sirius B was of the order of one ton to the cubic inch. It was shown by Eddington that this surprising density was not physically improbable, and further, that in the light of Einstein's general theory of relativity, the relative displacement of the lines of the spectrum of Sirius A and Sirius B could be estimated. The measurement when actually carried out by Adams in 1925 gave a result so near that of Eddington's estim-

ate that the computed small radius and high density of Sirius B may now be accepted with confidence. A few other stars besides Sirius B are known in which low luminosity and abnormal blueness are combined with high density; these are known as 'white dwarfs'. They are all within five parsecs of the sun, but there is no reason to suppose that this is an abnormal region of space. Consideration of the phenomenon of nova-outbursts and the study of the nuclei of planetary nebulae lead to the conclusion that the list of dense objects can be largely extended. The physical state of matter at these high densities has been elucidated by R. H. Fowler in the light of the researches of Fermi and Dirac. The existence of white dwarf stars shows that it is possible for any gas to exist in either of two states or phases, the 'perfect' or the 'degenerate' phase, the dense state being identified with that of the second phase of a gas. It is suggested that, as foreshadowed by Bessel in regard to Tycho's nova of 1572 the system of Sirius may owe its origin to the nova phenomenon of the original Sirius, two companions resulting, of which one re-expanded and the other remained dense. Bessel's anticipation of the interest of these phenomena in relation to our knowledge of the physical constitution of the universe has been amply justified by the course of events.

### Light-sensitive Cells

A PAPER read before the Royal Society of Arts on April 6 by Dr F H Constable gives an interesting account of light-sensitive cells in the service of man. Such cells may be divided into three classes, (1) photo-conducting cells which change their resistance on exposure to light, (2) photoelectric cells which emit electrons, and (3) photo-voltaic cells which exhibit the Becquerel effect. The last-named are electrolytic cells in which an electromotive force is created when either the electrolyte or an electrode itself is exposed to illumination. To these classes might now be added a fourth, illustrated by the modern cuprous oxide cell, which generates an electromotive force without the presence of an electrolyte. In this type the surface separating the oxide from the supporting copper plate seems to play an important part in the action, and recent theory would indicate the existence of a 'potential wall' at this surface.

After describing various forms which the light-sensitive cells may take, Dr Constable discussed the practical applications of such cells. The intensity of full moonlight measured by a photo-cell is about 0.2 lux, the unit of measurement (lux) being the light intensity 1 metre from a standard candle, while full starlight is of the order of 0.0002 lux in intensity.

One interesting application of the photo-cell is in the measurement of light intensity during the strong illumination of the day and during twilight. Over the period of a year there is very little seasonal variation in the minimum brightness at the time of sunset, while a certain amount of increase in the maximum values is noticeable in the summer and autumn months. It would appear that the principal factor which controls the intensity at dusk is the cloudiness of the sky. Rapidly moving clouds can produce very striking sudden irregularities in the brightness of the sky.

Circuits containing selenium cells may be used for turning lights on or off with the coming on of darkness and dawn. Other interesting applications mentioned are for race timing, apparatus counting, sorting, and burglar alarms. The use of the photo-cell to obtain good synchronisation in talking films is now a well-established practice.

### University and Educational Intelligence

MANCHESTER.—On May 11 the University celebrated the annual Commemoration of Founder's Day by holding a Congregation at which honorary degrees were conferred on Sir James Jeans (Doctor of Science), Dr W D Ross, Lord Rutherford, Sir Arthur Salter, and Mr W R Sickert (Doctors of Laws). The Chancellor, the Earl of Crawford and Balcarres, in his address, alluded to the distinction gained by the University in the award this year of five Royal Society medals, including the Copley medal, to past and present members of the staff. The honorary graduands were presented by Prof J L Stocks, and replies on their behalf were made by Sir James Jeans and Sir Arthur Salter. Sir James Jeans referred to the distinguished roll of physicists produced by the University, while Sir Arthur Salter, in the course of a discussion of the financial crisis, suggested that the discoveries of science are outstripping man's ability to control the powers they offer, and urged that universities ought to aim at producing men capable not merely of academic but also of administrative distinction.

THE Manchester Municipal College of Technology has issued a prospectus of evening courses of lectures

and laboratory work to be held during the summer, commencing May 30. The courses cover various branches of engineering, chemistry and chemical technology, textiles, mathematics, physics, and industrial administration.

THE work of the University of London during 1931-32 is reviewed in the Principal's recent annual report. Growth in the number of students continued steadily both on the internal and external sides, and there was a notable development of university extension work. Candidates for first degrees numbered 3675 and for higher degrees 652, the corresponding figures for the preceding year being 3543 and 548. The reconstitution of the University three years ago made possible an integration which has proceeded apace and proved its quality in vigorous reaction to the stress of hard times. The Court, beforehand in appreciating the need for restraint and encouraged by the Government's determination to continue undiminished the payment of university grants, volunteered to forego during the second half of 1931-32 and the whole of the following year ten per cent of the London County Council's maintenance grants, and to postpone claims on its capital grants so far as possible. In the face of a reduction of grants from the Board of Education and local education authorities for extension courses and adult tutorial classes, the Senate yet contrived to reduce the fees it charges for them. Among the checks to progress suffered in consequence of financial stringency were postponements of the development of the geophysics department of the Imperial College and of the construction of the East London College high voltage laboratory. The most momentous single event of the year was, perhaps, the selection of Mr C Holden as architect of the University buildings to be erected on the Bloomsbury site. A development involving a most important addition to the central institutions of the University is the transformation, to take effect next September, of the London Day Training College, hitherto a municipal institution, into a University department under the title of the Institute of Education.

AWARDS of Commonwealth Fund Fellowships tenable by British graduates in American universities for the two years beginning September 1932 include the following: Mr G C W Allan (Glasgow), to the University of Michigan, in mechanical engineering; Mr K E Boulding (New College, Oxford), to the University of Chicago, in economics; Dr J H Chesters (Sheffield), to the University of Illinois, in metallurgy; Mr K C Dunham (Durham), to Harvard University, in geology; Mr N E G Hill (University College), to Stanford University, in electrical engineering; Mr W A Macfarlane (Balliol College, Oxford), to the University of California, in physical chemistry; Miss M E Metcalfe (University College, Aberystwyth), to Johns Hopkins University, in entomology; Dr J Pace (Liverpool), to Princeton University, in physical chemistry; Mr W C Price (University College, Swansea), to Johns Hopkins University, in physics; Mr A S Roy (St Andrews), to the University of Michigan, in physics; Mr R M Shone, (Liverpool), to the University of Chicago, in business administration; Mr E T Stiller (Glasgow and St Andrews), to the Rockefeller Institute, in biochemistry; Mr George Tatham (University College, London), to Clark University, in geography; Mr D N Truscott (Imperial College of Science and Technology, London), to the Massachusetts Institute of Technology, in electrical engineering. The following have been appointed to Fellowships tenable by candidates from the British Dominions: Mr J H Kirk (Natal University College and Cambridge), to the University of North Carolina,



in social science, Mr A Smithies (Tasmania and Oxford), to Columbia University, in economics. The following have been appointed to Fellowships tenable by candidates holding appointments in government service overseas: Mr D W Dodwell (Indian Civil Service), to Columbia University, in economics, Mr C J Joubert (Department of Agriculture, South Africa), to the University of California, in entomology, Mr W M McNeill (Forest Department, Ceylon), to Yale University, in forestry.

### Calendar of Geographical Exploration

#### May 30, 1580 — The Kara Sea

Arthur Pet, in the *George*, accompanied by Jackman in the *William*, sailed from Harwich to search for the North-east passage. Pet was the first sailor from western Europe to reach the Kara Sea: he separated from Jackman at Vaygatz and the latter and his vessel were lost. On his journey from the Pechora eastwards, he discovered the strait between Vaygatz island and the mainland. Pet's voyage attracted a good deal of interest, and Barents took with him on his last journey a copy of Pet's journal. This was found, along with other books, frozen in among the remains of Barents' wintering on the north-east side of Novaya Zemlya, by the Norwegian walrus hunter, Gundersen.

#### May 31, 1869 — Novaya Zemlya

The Norwegian hunter, E H Johannesen, anchored at Mezhdushar Island, whence he sailed up the west coast of Novaya Zemlya in nearly open water. In the following year he circumnavigated the island. For the latter feat he was awarded a gold medal by the Norwegian Academy of Sciences, he had previously received a silver medal for his hydrographical work in the Kara Sea. His voyages and those of Carlsen and of John Palliser upset all previous theories about the state of the ice to the east of Novaya Zemlya. Carlsen's voyage of 1868-69 was of interest because he found on the north-east coast of Novaya Zemlya in 76° 7' N a house the roof of which had fallen in, and which was filled with gravel and ice. From this frozen gravel were recovered household articles, books, and boxes, preserved perfectly for nearly three hundred years since they were abandoned by Barents in 1597. In 1876 Charles Gardiner, by systematic excavations, discovered many other relics of Barents, including a short account of the most important incidents in the expedition, signed by Barents and Heemskerck. (See also entry for May 30 above.)

#### June 1, 1849 — David Livingstone

David Livingstone set out across the Kalahari desert and discovered Lake Ngami, in 1851, while exploring to the north of this lake, he discovered the Zambezi River, the existence of which in this region was unknown. Before he undertook his next journey, Livingstone studied astronomy in order to make his surveys more accurate. His 1852-56 journey altered completely the conception of the map of Africa. He went up the Liambai, the main Zambezi stream, crossed the Congo basin and reached the west coast at Loanda. Thence he returned to the Zambezi, discovered the Victoria Falls, and followed the river to the east coast, reaching Quilmane in 1856. Thus for the picture of a sandy desert in which rivers lost themselves he substituted a well-watered country, with grassy valleys, much fertile soil and great tracts of forest. He verified Sir R I Murchison's hypothesis that the continent presented an elevated plateau, somewhat depressed in the centre, from the sides of

which rivers flowed to the sea. A journey in 1858 resulted in the discovery of Lake Shirwa, and in the correction of erroneous ideas about Lake Nyasa. In 1866 he reached the southern shores of Lake Tanganyika, of which Burton and Speke had discovered the northern portion, and in 1867-68 discovered Lakes Mweru and Bangweolo. In October 1871 he met H M Stanley at Ujiji and together they explored the north of Lake Tanganyika. Livingstone refused to return with Stanley, he was consumed with eagerness to find the source of the Nile. He reached Lake Bangweolo and died there on April 30, 1830. Livingstone's achievements in African exploration secured his fame, his nobility and humane outlook gained him the warm affection of his countrymen and of the natives among whom he worked.

#### June 1, 1849 — The Great Salt Lake Region

Capt H Stansbury set out from Leavenworth on the Missouri River and discovered a new and shorter route through the Rocky Mountains to Salt Lake City. Stansbury and his assistant, Gunnison, surveyed the deserts to the west of the Great Salt Lake, the coast of the lake itself, and the region between Salt and Utah Lakes. The return journey was made from Fort Bridger, skirting the northern end of the Medicine Bow Mountains and the southern end of the Laramie Mountains to the North Platte River, a saving of about sixty miles. Besides exploring much new ground and making careful surveys, the expedition collected valuable data about the natural history and geology of the region and brought back accounts of life in the Mormon settlements.

#### June 2, 1773 — Ice Pack North of Spitsbergen

Capt C Phipps sailed with two vessels from the Nore and attempted to find a passage through the ice north of Spitsbergen. Their highest latitude was 80° 48' and they reached 20° E, examining the edge of the ice for more than 20° of longitude and finding no opening. Phipps Island was discovered on this voyage. A further exploration of the edge of the ice was made by Buchan and Franklin in 1818, during which they sailed from 10° E to 10° W but could find no opening.

#### June 2, 1910 — North-West Mongolia

D Carruthers set out from Kuzhabar, a village on the Russian frontier, to explore Mongolia. He surveyed the upper basin of the Yenisei River, mapping about 1800 square miles, and filling in many gaps. He then explored the Barkul-Hami district. Carruthers had spent 1908 in the western Tian Shan, south of the Naryn River. In 1909 he had travelled in Arabia, reaching Tema by a route west of El Jauf.

#### June 3, 1870 — Western Borderlands of Arabia

Joseph Halévy, a Jew of French nationality, arrived in Nejrán. This is probably the 'Negrana' of Ælius Gallus, Eparch of Egypt, whose expedition was described by Strabo. From that time until Halévy's journey, no European had visited it. Halévy travelled in the character of a learned rabbi of Jerusalem, and, setting out in 1869, crossed Jabel Yam, the highest ridge of the Yemen, and discovered the ruins of Min. Thereafter he crossed the fringes of the terrible Akháf, suffering much, but finally reaching his goal. He returned to Jauf by a more westerly and less desert route, across valleys on the eastern fringe of the Sachan plateau, in which were many ruins. In spite of the fact that his interests were mainly archaeological, his extensive journey resulted in geographical knowledge of much hitherto entirely unexplored country.

## Societies and Academies

## LONDON

Physical Society, April 15—H E Beckett The measurement of reflection coefficients for radiation at oblique incidence The material is spread upon the metal receiver of a thermopile which, when exposed to radiation, yields an e.m.f. proportional to the absorption coefficient of the surface Results obtained with black and white paints and with polished copper are discussed —W Ewart Williams A new type of interference refractometer The beam from the central part of the collimator objective is divided and each half laterally displaced After passing through the gas tubes, the beams are again reunited so that the interference pattern at the focal plane of the telescope objective is similar to that from a two-plate transmission echelon The brightness of the fringes is approximately twenty times greater than with the usual Rayleigh interferometer, so that the instrument can be combined with a spectrograph for dispersion measurements A new method, based on Benoit's 'fractional part' principle, is developed for this purpose —L G Grimmett A direct reading  $\gamma$ -ray electroscope A dead-beat direct-reading  $\gamma$ -ray electroscope having a linear scale graduated in milligrams of radium is described It is a combination of a special ionisation chamber, Lindemann electrometer, and high resistance, and allows the estimation, in less than three seconds, of the activity of small  $\gamma$ -ray sources of the order 1 mgm radium with an accuracy of 0.5 per cent on a full-scale deflexion

Society of Public Analysts, May 4 —W. R. Schoeller and A R Powell The separation of tantalum, niobium, titanium, and zirconium, and a new analytical grouping The authors' recent method for the separation of titanium from zirconium, based on precipitation of the titania as tannin complex from the nearly neutralised oxalate solution half saturated with ammonium chloride, affords a quantitative separation of tantalum, niobium, and titanium ('acid tannin group') from zirconium, thorium, and aluminium ('basic tannin group') —P S Arup The iodine and thiocyanogen value of Irish butter The iodine value of Irish butter fat rises from May to October and then falls again, owing mainly to the influence of the winter feeding factor The thiocyanogen value (affording a measure of the linolic acid) is higher in winter than in summer, indicating a tendency for the linolic acid to increase as the oleic acid decreases The proportion of linolic acid in the unsaturated fatty acids in Irish and foreign butters ranged from 9.1 to 13.2 per cent —C Ainsworth Mitchell and T J Ward Sediments in ink and in writing Among the external causes producing sediments recognisable in writing are alkali in glass, moulds, and extraneous substances such as dust, vegetable debris, and starch A new method of detecting oxidase in moulds, etc., has been based on the acceleration of the oxidation of a solution of tannin and ferrous sulphate by the substance containing the oxidase, the resulting precipitate of basic ferric tannate being collected and weighed —L G Haddock and Norman Evers The determination of minute amounts of copper in the presence of iron and certain other metals The separation of copper from iron by means of ammonia or hydrogen sulphide is incomplete An accurate method consists in keeping the ferric iron in solution by addition of citric acid and ammonia, adding sodium diethylthiocarbamate (Callan and Henderson), extracting the solution with carbon tetrachloride (Grindel), and measuring the colour of the extract in a tintometer, or comparing it with standards

containing known amounts of copper So little as 0.005 mgm of copper may be detected in the presence of 0.25 gm of iron

Royal Meteorological Society, May 18 —G Bransby Williams The rainfall of Assam Assam is the wettest province of the Indian Empire, and contains Cherrapunji (where the mean annual rainfall is 460 in.), reputed to be the wettest place in the world The period of the south-west monsoon is of greater length in Assam and Burma than in north and central India In consequence there is a marked difference between the seasonal distribution of the rainfall in these countries On an average, in the Central Provinces 87.6 per cent of the year's rain falls in the four months June to September, whereas in Assam only 65.9 per cent falls during these months The chance is 400 to 1 against the rainfall at any station in Assam in any one year being below 50 per cent of the mean —J Wishart On the secular variation of rainfall at Rothamsted A detailed study of the rainfall at Rothamsted over the 76 harvest years, 1854–1929, shows that the maximum in autumn (and equally the minimum in spring) occurs significantly later to-day than was the case 76 years ago, but there is some sign that this movement is now reversing its direction, as appeared to have happened towards the end of the eighteenth and again in the middle of the nineteenth centuries, as judged from early records at a number of other stations —C E P Brooks and Theresa M Hunt The zonal distribution of rainfall over the earth The mean annual rainfall in each five-degree zone was calculated separately for the land and sea areas by a planimetric method, using the best available rainfall charts for each country or ocean The results show maxima over the land in latitude  $0^{\circ}$ – $5^{\circ}$  S and  $50^{\circ}$ – $60^{\circ}$  S, a minimum in latitude  $30^{\circ}$  S, over the sea, maxima in  $50^{\circ}$  N,  $0^{\circ}$ – $10^{\circ}$  N, and  $40^{\circ}$ – $45^{\circ}$  S, minima in  $40^{\circ}$ – $50^{\circ}$  N,  $20^{\circ}$ – $30^{\circ}$  N, and  $20^{\circ}$  S

## EDINBURGH

Royal Society, March 7 —N A Mackintosh Research on whales in the Antarctic (lecture) Observations have shown no racial distinctions between the whales of South Georgia and South Africa, but considerable differences exist in the make-up of the local whale populations There is a definite breeding season in the winter, and the young are born in the following year Sexual maturity is reached about two years after birth The high proportion of immature whales killed is prejudicial to the stock and to the whaling industry itself The work of the *Discovery*, the *William Scoresby*, and the *Discovery II* has been concerned mainly with the whales' environment in the Atlantic sector of the Southern Ocean The main currents and water masses have been measured and charted, and the circulation of the nutrient salts determined Detailed investigations have been made on the plankton *Euphausia superba*, the food of whales, is widely distributed, but its northern limit is usually defined by the  $3^{\circ}$  isotherm

## PARIS

Academy of Sciences, April 11 —Paul Montel A formula of Darboux —Michel Fekete The changes of sign of a function in the interval  $0, \infty$  —Miron Nicolesco The extension of a theorem of F Riesz to subharmonic functions of order  $p$  —S K Jaremba The differential equations corresponding to surfaces of genus one —D Riabouchinsky The movement of an incompressible fluid round an obstacle —Basile Demtchenko The slow movements of compressible fluids —Georges Durand The determination of the

velocity due to indefinite rows of vortices —J Thibaud, J J Trillat, and Th v Hirsch Researches on the polarisation of a bundle of electrons by crystalline reflection The experiments described and illustrated leave the question of the existence of polarisation doubtful —Dinca Samuracas The influence of the magnetic field on crystallisation The magnetic field changes the direction of the currents in the liquid due to changes in concentration It is shown by experiment that crystallisation can be affected by a magnetic field —Constantin Salceanu The influence of substitutions on the magnetic rotation and double refraction of naphthalene derivatives, the comparison of the rotatory dispersions and magnetic double refraction —Mme Irène Curie and F Joliot The nature of the penetrating radiation excited in light nuclei by the  $\alpha$ -particles The experiments described support the hypothesis of the neutron of mass 1 and charge 0 The nuclei of beryllium irradiated with the  $\alpha$ -rays of polonium emit a complex radiation including a  $\gamma$ -radiation emitted approximately equally in all directions and a very penetrating radiation (1 cm of lead absorbs about 6 per cent) emitted unsymmetrically with respect to the direction of the incident  $\alpha$ -particles —Mme P Curie and S Rosenblum The fine structure of the magnetic spectrum of the  $\alpha$ -rays of radioactinium The large electromagnet of the Academy of Sciences was utilised in these experiments The results of the measurements of eight lines are given —G Mano The slowing down of the  $\alpha$ -rays of thorium-C' in air —A Portevin, E Prétet, and H Jolivet Structural hardening by heating the iron-nickel-tungsten alloys —F Bourion and E Rouyer The cryoscopic study of ether and acetone in water and in solutions of sodium chloride —Marcel Boil Chemical kinetics in receivers surrounded with a great thickness of mercury Comparative measurements of the hydrolysis of tetrachloroplatinic acid in the dark and surrounded by 10 cm of mercury showed that the velocity constant of the reaction in the latter case was one-sixth that in the former The cosmic rays are suggested as affording a possible explanation —D Rosenthal and M Mathieu Mild steel welds made with the electric arc Effect of coated electrodes from the point of view of distortion of the crystalline grains —Jean Bouchard The photosensitising action of colourless fluorescent materials on the flocculation of colloidal solutions Solutions of colloidal arsenic sulphide to which various colourless fluorescent substances were added were exposed to ultra-violet light In each case there was a marked acceleration of flocculation —Ed and R Chauvenet The formation of compounds in aqueous solution of thoryl chloride and alkaline chlorides The thermochemical method pointed to the formation of molecular compounds of the type  $\text{ThOCl}_2 \cdot \text{MCl}$  The caesium and potassium compounds were isolated in crystalline form —Raymond Delaby The vinylaryl and vinylalkyl carbinols their transformation into  $\beta$ -homoacroleins —André Meyer and Robert Vittenet The preparation of homophthalic acid by the oxidation of indene Homophthalic acid can be prepared with 66 per cent yield by the oxidation of indene with potassium bichromate and sulphuric acid in the proportions given —P Russo The position of the northern border of the Morocco Meseta L Dubertret, A Keller, and H Vautrin Contribution to the geology of the Djezireh (Syrian territory on the left bank of the Euphrates) —Paul Chauchard The factors of variation of the reducing power of sea water —A Guillermond Cytological observations on the Rhodothobacteria —Th Savulescu and T Rayss The influence of external conditions on the development of *Negrospora Oryzae*, a parasite of maize in Roumania —R Bonnardel and W Liberson Re-

searches on the physiology of human work at high altitudes Comparative study of metabolism, cardiac frequency, and mental fatigue at Paris and the physiological laboratory on the Jungfrauoch (3457 metres) Raoul Lecoq The rôle of the B vitamins and of the food equilibrium in the utilisation of the proteins —L Genevois and Tamara Nicolaieff The prevention of bacterial lactic fermentation by the  $\alpha$ -halogen substituted fatty acids —H Bierry Specificity and chemical structure —Georges Defandre *Litharchaeocystis costata*, a marine fossil Chrysophyceae. Remarks on the Chrysostomataceae —C Levaditi and N Constantinesco The penetration of the syphilitic virus in spontaneous neoplasms and lymphadenoma, in mice —P Lépine and J. Caminopetros The action of the serum of patients cured of exanthematic typhus and of *fièvre boutonneuse* on the exanthematic virus of Athens rats —A Leulier, B Pommé, and A. Richard Potassium and chronaxy in experimental muscular degenerescence

## ROME

Royal National Academy of the Lincei, Dec 20 —G Armellini and G Conti Investigations on the variations of atmospheric absorption and various observations At Rome, atmospheric absorption is slightly less in winter than in summer, but the difference does not seem to exceed 25 per cent Observations on planets, and on the position of Uranus during its conjunction with  $\alpha$  Piscium, are recorded —T Boggio Fresnel's wave-surface —G Lampariello Levi-Civita's differential equations in the problem of liquid jets. Levi-Civita has recently treated analytically the problem of liquid jets of the very small thickness compared with the length when the internal pressure in the neighbourhood of the orifice remains sensibly above the atmospheric pressure The application to this system of the general theorem of existence and unicity is now considered —G Gallina Homogeneous functions —M Crenna Ribaucour's deformable congruences —M Manarini A theorem of Staude-Wan der Woude relating to the motion of a heavy body about a fixed point When a heavy body is suspended at a fixed point  $O$ , there exist an infinite number of straight lines through  $O$  which form a quadric cone (Staude's cone) and are, for the body, axes of permanent uniform rotation with suitable angular velocity Wan der Woude showed that such a cone is formed of those straight lines through  $O$  which are principal axes of inertia with respect to one of their points It is now shown that these propositions may be simply derived and completed by deducing, for the duration of a whole permanent rotation, a formula identical with that of Galileo for the simple pendulum —G Piccardi Molecular spectra and spectroscopic analysis (1) In spectra containing large numbers of lines, identification of an element is often difficult or uncertain In such cases, more valuable information may be obtained by using less powerful means of excitation and examining the band spectra produced —A Rossi and G Scoz Presence of an acid-soluble organic phosphorus compound in the sub-maxillary gland of the dog This gland contains about 140 mgm of phosphorus per 100 gm of the dry tissue, about 40 mgm. of the phosphorus being in the form of an acid-soluble compound Part at least of the latter is determinable only after incubation of the acid extract at  $37^\circ$ , this indicating a labile organic phosphorus compound of behaviour resembling Eggleton's phosphagen —G Scoz Investigations on cystine metabolism Experiments on rats and puppies show that cystine exerts a favourable influence on the general bodily growth and on the growth of the hair

## Forthcoming Events

## FRIDAY, MAY 27

- LONDON SCHOOL OF ECONOMICS, at 5—Prof L Hogben  
The Biological Premises of Historical Interpretation  
(Lecture)
- ROYAL ANTHROPOLOGICAL INSTITUTE (Human Biology  
Research Committee), at 5 30—Discussion on the  
Standardisation of Anthropometric Method
- BIRKBECK COLLEGE, at 6—Dr H J W Hetherington  
Theory and Practice (Haldane Memorial Lecture)
- ROYAL SOCIETY OF MEDICINE (Epidemiology and State  
Medicine Section) (Annual General Meeting), at 8—Sir  
Aldo Castellani The Epidemiology of Some Typical  
Mycoses
- ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Sir Walter  
Morley Fletcher New Conceptions of Medical Research

## SATURDAY, MAY 28

- NORMAN LOCKYER OBSERVATORY (Salcombe Regis, Sid-  
mouth), at 3 30—Opening by Sir Frank Dyson of the  
'Mond' Photographic Equatorial and Dome Other  
speakers Sir Richard Gregory, Bart, Dr R L Mond,  
and others
- ROYAL SOCIETY OF MEDICINE (Physical Medicine Section)  
(at Alton)—Annual Summer Meeting

## MONDAY, MAY 30

- INSTITUTION OF ELECTRICAL ENGINEERS (Summer Meeting  
at North Midland Centre) (*continued on May 31 to  
June 3*)

## TUESDAY, MAY 31

- INTERNATIONAL NEUROLOGICAL CONGRESS (at Paris) (*con-  
tinued on June 1*)

## WEDNESDAY, JUNE 1

- OXFORD UNIVERSITY (in Sheldonian Theatre), at 12 noon  
—Lord Moynihan The Advance of Medicine (Romanes  
Lecture)
- ROYAL SOCIETY OF MEDICINE (Surgery Section) (at General  
Infirmary, Leeds)—Annual Provincial Meeting

## JUNE 1 TO 4

- SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (Congress  
at the Civil Service Commission, Burlington Gardens,  
W 1)

Dr R E Mortimer Wheeler Field Archaeology in  
Great Britain (Presidential Address)

Dr W E St L Finny Medieval Games and Gader-  
ings (Presidential Address to Archaeology Section)

J Ramsbottom Fungi as Scavengers (Presidential  
Address to Botany Section)

Prof H L Hawkins The Structure of the South-  
East of England (Presidential Address to Geology  
Section)

H Main The Camera as a Naturalist's Recorder  
(Presidential Address to Zoology Section)

G L Pepler Town and Country Planning (Presidential  
Address to Regional Survey Section)

Sir Arthur Thomson The Drama of Animal Life  
(Evening Lecture)

Capt G Dollman Great Game Animals of Africa  
(Evening Lecture)

- NEWCOMEN SOCIETY (Summer Meeting in N E Stafford-  
shire)

- INSTITUTE OF TRANSPORT (Congress at Buxton)

## THURSDAY, JUNE 2

- ROYAL SOCIETY, at 4 30—Prof C U Ariens Kappers  
Some Correlations between the Brain and the Skull  
(David Ferrier Lecture)

- ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5—Dr  
J W McNee The Liver and Spleen their Clinical  
and Pathological Associations (Croonian Lectures) (1)

## FRIDAY, JUNE 3

- PHYSICAL SOCIETY OF LONDON AND OPTICAL SOCIETY (at  
Imperial College of Science and Technology), 2 30 to  
5 30, and 7 to 9 30—Joint Discussion on Vision

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- ROYAL SOCIETY OF MEDICINE (Disease in Children Section),  
at 5 30—Annual General Meeting
- ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Prof J C  
McLennan Electrical Conductivity of Metals at the  
Lowest Temperatures

## SATURDAY, JUNE 4

- ROYAL OBSERVATORY, GREENWICH, at 3 30—Annual  
Visitation
- INSTITUTION OF ELECTRICAL ENGINEERS (London Students'  
Section)—Summer Outing to Southampton

## Official Publications Received

## BRITISH

- Department of Scientific and Industrial Research Building Science  
Abstracts Vol 5 (New Series), No 3, March Abstracts Nos 389 575  
Pp 73 108 (London H M Stationery Office) 1s net
- Journal of the Royal Microscopical Society Series 3, Vol 52, Part 1,  
March Pp xvi+112 (London Royal Microscopical Society) 10s net
- Government of India Department of Industries and Labour (Public  
Works Branch) Triennial Review of Irrigation in India, 1927-30 Pp.  
iii+61. (Simla Government of India Press) 1 8 rupees, 2s 6d
- The National Physical Laboratory Report for the Year 1931 Pp  
vi+313+11 plates (London H M Stationery Office) 15s net
- Government of India Meteorological Department Magnetic, Meteor-  
ological and Seismographic Observations made at the Government  
Observatories, Bombay and Alibag, in the Year 1928, under the direction  
of Dr S K Banerji, with an Appendix relating to the Climatology of  
Bombay Pp iv+160+5 plates (Calcutta Government of India  
Central Publication Branch) 14 rupees, 22s 6d
- Proceedings of the Cambridge Philosophical Society Vol 28, Part 2,  
30 April Pp 165 255 (Cambridge At the University Press) 7s 6d net
- Journal of the Chemical Society April Pp v+985-1385+vi (London.  
Chemical Society)
- Report of the Kodaikanal Observatory for the Year 1931 Pp 4  
(Calcutta Government of India Central Publication Branch) 6 annas
- Investigations on the Spike Disease of Sandal 4 Report of Progress  
made during the Quarter ending 31st December 1931 Edited by Dr  
V Subrahmanyam Pp ii+16 (Bangalore Indian Institute of Science)
- Sands, Clays and Minerals a Magazine devoted to Economic Minerals  
Issued quarterly Vol 1, No 1, April Pp 40 (Chatteris Alghernon  
Lewin Curtis) 5s per annum
- The Indian Forest Records Silviculture Series, Vol 15, Part 4  
Volume Tables and Diameter Growth Curve for Semal (*Dombax malaba-  
ricum* DC) By Ishwar Das Mahendru Pp iv+21+2 plates 9 annas,  
1s
- Entomology Series, Vol 16, Part 11 Immature Stages of Indian  
Coleoptera (10) (Anthribidae) By J C M Gardner Pp ii+8+1 plate  
5 annas, 6d (Calcutta Government of India Central Publication  
Branch)

## FOREIGN

- The Memoirs of the Imperial Marine Observatory, Kobe, Japan Vol 5,  
No 1, March Pp 49 (Kobe)
- Mitteilungen der Naturforschenden Gesellschaft Bern aus dem Jahre  
1931 Pp xiv+146 (Bern Paul Haupt)
- Department of the Interior Office of Education Bulletin, 1932, No 4  
Record of Current Educational Publications, October-December 1931  
Pp v+143 (Washington, D C Government Printing Office) 10 cents.
- Transactions of the San Diego Society of Natural History Vol 7,  
No 7 A New White footed Mouse from Lower California, Mexico By  
E W Nelson and E A Goldman Pp 51 52 Vol 7, No 8 The Eocene  
Sierra Blanca Limestone at the Type Locality in Santa Barbara County,  
California By Marvin Francis Keenan Pp 53 84+plates 2 4 Vol 7,  
No 9 A New Cardita from the Aleutian Islands and a New Epitonium  
from Southern California By George Willett Pp 85 90+plate 5  
Vol 7, No 10 Fossil Corals of the Genus Turbinolia from the Eocene  
of California By E H. Quayle Pp 91 110+plate 6 (San Diego,  
Calif)
- U S Department of the Interior Geological Survey Water Supply  
Paper 662 Surface Water Supply of the United States, 1928 Part 2  
South Atlantic Slope and Eastern Gulf of Mexico Basins Pp v+129  
25 cents Water Supply Paper 688 Surface Water Supply of the United  
States, 1929 Part 8 Western Gulf of Mexico Basins Pp v+131.  
25 cents Water Supply Paper 690 Surface Water Supply of the United  
States, 1929 Part 10 The Great Basin Pp v+86 15 cents.  
(Washington, D C Government Printing Office)
- Journal de la Societe des Americnistes Nouvelle Serie, Tome 23,  
Fasc 2 Pp xxviii+273 606 (Paris)
- Journal of the Faculty of Agriculture, Hokkaido Imperial University,  
Sapporo, Japan Vol 26, Part 3 Flora of Hokkaido and Saghalien 3.  
Monocotyledoneae, Araceae to Orchidaceae By Kingo Miyabe and  
Yashun Kudo Pp 279 387 (Tokyo Maruzen Co, Ltd)
- Society for the Promotion of Engineering Education Summer School  
for Engineering Teachers, Bulletin No 18 Outline of the History of  
Mathematics By Prof Raymond Clare Archibald Pp 53 (Lancaster,  
Pa The Lancaster Press, Inc) 30 cents
- The Carnegie Foundation for the Advancement of Teaching Twenty-  
sixth Annual Report of the President and of the Treasurer Pp vi+129  
(New York City) Free

## CATALOGUES

- Nickel B9 Austenitic Cast Irons Pp 16 (London The Mond  
Nickel Co, Ltd)
- B D H Vitamin Products Pp 4 (London The British Drug  
Houses, Ltd)



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## Chemical Warfare and Disarmament

ADDRESSING the House of Commons on May 13 on disarmament, Sir John Simon, Secretary for Foreign Affairs, said that everyone would agree it was desirable to enter into an agreement, and make effective its observance, against the use of poison gas in warfare. It was an example of 'qualitative' disarmament, contrasted with 'quantitative' disarmament, aiming at a limitation of the number and size of ships and the calibre of guns. Sir John Simon's declaration was received with cheers, and his argument was reinforced in the debate by Mr Winston Churchill, who laid stress on the indiscriminate character of gas warfare, entailing death and wounds not merely to combatants but also to the civil population, men, women, and children, far removed from the area of hostilities. He pointed out that the acceptance among the leading authorities of different countries of the bombing of open towns would introduce a new idea into warfare, "an idea not compatible with any civilised decency". Are we to allow ourselves to be led, step by step, into contemplating such hideous episodes as part of the ordinary give and take of war?

The question is one with which our chemists—and by the same token our physicists and bacteriologists—who create in their laboratories the raw material, *fabrika fabris*, for scientific warfare, are directly concerned, a question which has caused searchings of hearts and consciences, not resolved by ordinary appeals to patriotism. Dr Delisle Burns's letter published this week in our correspondence columns affords evidence of these misgivings. But it is safe to say that men of science as a whole would not approve of any limitation of the scope and character of scientific research into poisons or any other branch of science which may find application in warfare. No Pope of Geneva must be allowed to compile an *index expurgatorius* for men of science. "Why, sir," said Dr Johnson, "that knowledge may, in some cases, produce unhappiness, I allow. But, upon the whole, knowledge, *per se*, is certainly an object which every man would wish to attain." Moreover, as Major Lefebure points out in "The Riddle of the Rhine", if every chemist in the world became a pronounced pacifist, new chemical warfare substances would undoubtedly arise as a normal outcome of research.

It is well to know, however, that the question of disarmament is being studied in all its aspects, officially and unofficially. The report of the Inter-Parliamentary Union on "What will be the Character of a New War?" (P S King and Son) includes

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a section on chemical and bacteriological warfare, by Dr Gertrud Woker, of Switzerland, setting out the general preparations for war, expert views on the effects of chemical warfare, the medical effects of poison gas, and protection of the civilian population. Reference is made to the Report of the American Government on the proposals of the Mixed Committee of the Preparatory Disarmament Commission, in which the view is expressed that the absolute prohibition of training men in the use of chemical weapons in the widest sense would put an end to chemical and medical studies and research, so that such a measure could not possibly be put into practice. In 1924-25, the United States budgeted for an expenditure of 8,700,000 dollars on chemical defence measures. The great chemical industries, that country asserts, are bound together by their common capital and collaborate to supply each State, under the auspices of the military authorities, with the materials for national defence should the need arise.

Retaliation over enemy territory appears at present to be the only effective defence against chemical warfare in its application to cities. Arming the whole civilian population with masks is, according to one expert, "unthinkable". The provision of ventilated underground refuges is also impracticable. Air manœuvres over London have proved incontrovertibly we are told, that in the case of serious attack, a great part of London would be destroyed. Of 250 aeroplanes taking part in a night attack, only sixteen were discovered by searchlights. Prof Langevin has come to much the same conclusion in regard to Paris. He estimates that 100 aeroplanes, each carrying a ton of gas, could in an hour cover Paris with a gas cloud 20 metres thick, and if there were no wind, Paris would be annihilated. Prof Noel Baker in his book "Disarmament" (1926) says that the "Berlin bombs" prepared for use in the 1919 campaign would have killed every person in the open within 600 to 800 metres of the spot where the bombs exploded.

Progress is continually being made not only in the potency of chemical poisons but also in the art of mixing poisons to produce desired effects. Chlorine, the first gas used, is now superseded because its action is too sudden and its presence in the atmosphere too obvious. Mustard gas, used in the production of indigo, still retains its evil pre-eminence, for no method of counteracting some of its effects has been discovered. Dr Gertrud Woker concludes her report with a statement that, as things stand at present, war mania

would aim only at the complete and unscrupulous destruction of the enemy. "How long", she asks, "is the flower of each nation, and even every nation as a whole, to be sacrificed to this Moloch?"

Is the picture as black as painted? Is the gloom as unrelieved as even Sir John Simon—for whose *aequanimitas* in these difficult times the nation has every reason to be grateful—would have us believe? For an answer we may turn to an article by James E. Mills on chemical warfare in the April issue of *Foreign Affairs*, a quarterly review published by the American Council for Foreign Relations. In reality, he says, the propaganda against it notwithstanding, gas is the most humane weapon existing to-day in actual warfare. He proves by statistics that the proportion of deaths resulting from gas is far below the general proportion, as 2 per cent to 24 per cent in the case of American casualties. Gas does not mutilate, and it seldom causes extreme pain, those gases which poison without pain being preferred. Its use can be controlled, for example, tear gas will disperse a mob without fatalities unavoidable by the use of machine guns. It is a relatively cheap weapon, and thus makes for equality between large and small nations. "It is possible to assert", he claims, "that the new and powerful weapons of war made possible by science may be a gain to the world." Gas warfare is particularly powerful as a defensive weapon, for reasons which will be obvious. He thinks the dangers of attacks on cities are over-estimated. *Omne ignotum pro magnifico!*

Research on new poisonous compounds cannot be limited, for they play a necessary part in the development of insecticides, fungicides, germicides, disinfectants, preservatives, fumigants, and drugs. It has been estimated that the destruction caused by insect and animal pests in the United States reaches the astonishing total of more than two billion dollars a year. The bubonic plague in India alone cost 8,000,000 lives in the first ten years of this century. As becomes a writer who is able to discuss a question in a scientific spirit, Mr Mills concludes his article with a constructive suggestion. Whether a nation at war under present conditions would drench with poison gas the great cities of an enemy country, with the full knowledge that retaliation would follow, may be left an open question. No objection should be taken, he suggests, to the use of tear gas in war, owing to its non-fatal character. So far as protection can be afforded by treaty, he thinks that the use of poison gas should be allowed only in a nation's own territory as a means of defence. In this way, civilian



populations would be protected, if treaties were observed

Disarmament must be studied scientifically—coldly and dispassionately, without “laziness, haziness, craziness”, *surtout* without any trace of hysteria. Dr Cyril Norwood, headmaster of Harrow, in his presidential address last January to the Science Masters’ Association, appealed to “scientists” to create a community “which will put spell-binders and slogan-manufacturers of modern politics and journalism out of commission”. We are gratified that our own scientific men, with knowledge and experience, have made contributions to the discussion of disarmament satisfying these criteria. Particularly we would cite Major Victor Lefebure’s “Scientific Disarmament a Treatise on the Facts of Armament”, reviewed in *NATURE* of April 4, 1931. Our reviewer sounded a note which finds an echo in the present article. “Our failure to grapple with the facts of disarmament”, he wrote, “still allows politicians to find an easy refuge in moral and economic platitudes”. Disarmament, as Major Lefebure insists, is a technical matter, requiring close and continuous study by scientific methods, especially to secure the extension of the ‘conversion lag’ between the issue of war and the exploitation of the vast resources placed at the disposal of the combatants by science and industry. Science has discovered the poison it will discover the antidote.

Let us continue our journey, holding the dim taper put into our hands, singing songs of comfort as we go along. May it light us to a world where there shall be no more war between nations—and between people living in the same street! Spell-binders, slogan-manufacturers, schoolmen, babbling sophists merely inspissate the gloom.

### W. H. Dines's Scientific Papers

*Collected Scientific Papers of William Henry Dines, B.A., F.R.S.* Pp. x + 461 (London: Royal Meteorological Society, 1931) 15s. net

THE Royal Meteorological Society is to be congratulated on its decision to reprint the scientific papers of Mr W. H. Dines as a memorial to that eminent meteorologist. The book, which has now appeared, fulfils its purpose admirably and is a credit to the Society as well as an honour to one of its most distinguished fellows. England owes a great deal to its band of amateur men of science, and meteorology probably owes more to the amateur than any other of the major branches of science. Mr W. H. Dines was an amateur in the best sense

of the word. He took up meteorology because it made its own appeal to him, no doubt influenced to some extent by the meteorological work of his distinguished father, Mr George Dines. This compilation of his papers brings home to the reader what a large part Dines played in the development of scientific meteorology in Great Britain, but it also helps those of us who knew the man and read each one of his papers as it appeared to see his work as a whole, and to judge how much of it will be of permanent value and how much of it was laying the foundations on which others have built. It is probably in the last respect that Dines made his greatest contribution to science. Throughout his scientific life Dines was a pioneer, he had the instincts of a pioneer, and the methods of a pioneer. His tools were always of the crudest, without any refinement and without any unnecessary accuracy, but capable of doing the job for which they were designed.

Dines’s method of measuring wind pressure by the use of a rotating arm driven by an old second-hand steam engine in the open air will appear crude in the extreme to the worker in a modern aerodynamic laboratory with its wind tunnels and delicate balances, but his method of eliminating the velocity by balancing the wind pressure on the plate against the centrifugal force, both of which depend on the square of the velocity, was a stroke of genius. With this crude apparatus Dines provided data of the wind pressure on plates of different sizes and shapes which were used by engineers and meteorologists until the advent of aviation raised aerodynamics to a separate science. The nine papers on anemometry which form the main part of Section I of the book are valuable records of the first steps in this new science, although they had all been written before aviation had appeared on the scene as a practical proposition. Most of them, naturally, have now only a historical interest, but it would be well if the younger workers in our aerodynamic laboratories would read them to see what can be done without elaborate instruments.

Towards the end of the nineteenth century meteorologists on the Continent and in America had commenced to investigate the upper atmosphere by means of balloons and kites, but no work was being done in the British Isles. This was largely due to the want of money, for the instruments were expensive and many were lost. This was an unknown country which had a great attraction for Dines’s pioneering spirit. He took up kite-flying with great energy. The kites used on the Continent were expensive, fragile structures, so he devised his own kites, which were inexpensive.

and by comparison unbreakable—in any case, it cost little to repair them. He built a winding gear which was a marvel of ingenuity but which caused engineers to smile. He bought another steam engine (Dines loved a steam engine, especially the one which sometimes drove his motor-car) to drive the winding gear, and above all, he designed a meteorograph recording pressure, temperature, humidity, and wind which cost less than a tenth of the instruments used in Germany and America. Later on, when the discovery of the stratosphere shifted interest from the lower to the upper atmosphere, he abandoned kites for balloons. Here again he developed an instrument of which the chief characteristic was cheapness combined with sufficient accuracy.

With these simple and inexpensive instruments Dines carried out the work which forms Section II of the collected papers. The early experiments and instruments are fully described, and a series of papers gives the results obtained, first with kites and then with balloons. Finally, the whole work is summed up in a paper entitled "The Characteristics of the Free Atmosphere", published in 1919, which is still the chief source of our information about the upper atmosphere over the British Isles.

In 1922, Mr. Dines passed on his work on the upper atmosphere to his son, L. H. G. Dines, who is still in charge of this work at Kew Observatory. But Dines could not give up his interest in meteorology, it was only transferred, and this time to another branch which was sadly in need of a pioneer. A great deal of work had been done for a number of years by many eminent men on the part played by radiation in the distribution of heat in the atmosphere, but it cannot be said that they had got very far. It is a difficult subject and one requiring a whole army of pioneers to blaze a way through a very forest of physical difficulties. The third section of the book is devoted to papers describing his work on radiation, which commenced in 1917 and continued to the time of his death. The characteristics of this section are similar to those of the two already described: the approach to a difficult and almost unexplored subject, the design of instruments, the record of careful observation, and a valuable discussion of the results obtained. This work is also being continued at Kew Observatory.

The final section of the book deals with a number of miscellaneous papers, the chief of which is, probably, an address delivered before the Sanitary Institute so long ago as 1895, which received much public attention at the time because of his insistence

on the necessity for a low temperature and fresh air if health is to be preserved.

In order to save expense, a method of reproduction of the original papers has been adopted which is somewhat unusual in Great Britain, to quote from Sir Richard Gregory's preface, "To have set up the papers again in a uniform type would have involved the Council in greater expense than was contemplated when the project of publishing the volume was conceived. It was decided, therefore, to adopt the less costly method of lithophotography or 'offset' printing for the work. By this process the original pages are photographed, and the plates thus made are used for printing, with necessary adjustments of portions of pages, and with new or supplementary matter set up in type in the usual manner." I think there will be general agreement that the experiment has been entirely successful. The printing is obviously not quite so sharp as in the originals, but the majority of readers would not notice this unless their attention were directed to it. Personally I welcome this reproduction of the papers in their original form, for many of them made a strong appeal to me when they were first published and it is pleasant to come across the old diagrams and the old familiar type. The pleasure in reading again these old friends would have been much less if they had been re-dressed, even if in better clothes.

G. C. SIMPSON

### Scottish Medical History

*History of Scottish Medicine* By Dr. John D. Comrie. Published for the Wellcome Historical Medical Museum. Second edition. Vol. 1. Pp. 400. Vol. 2. Pp. 401-852. (London: Baillière, Tindall and Cox, 1932.) 50s. net.

IF the history of medicine in other countries is so full of human interest as Scottish medical history is shown to be in this work, we can understand its fascination. The appeal is not merely medical but also covers the whole range of the allied sciences. Moreover, a nation's medical history is so intimately associated with that of its people and its progress, that laymen, as well as physicians and men of science, will find instruction and enjoyment in these volumes of Scottish medical history.

Dr. Comrie, the author, has been for the past twenty-four years lecturer on the history of medicine in the University of Edinburgh. The book shows him to possess highly specialised knowledge of his subject, combined with the ability to clothe his facts in a fascinating literary garb. He is obviously convinced that illustrations are an

essential adjunct to the appreciation of historical records, serving, as they do, not only to gratify the eye but also to make the retention of facts easier and perusal of the work more pleasurable. His illustrations are lavish, they are obviously also authentic and apt. A special word of praise may be accorded to their quality and clearness of reproduction. This part of the work, as well as the writing, has obviously been done by a master hand. We refer particularly to this point because it happens, more often than not, that well-written works of this kind are spoiled, or lowered in value, by poor and inadequate illustrations.

The fact that the work is published for the Wellcome Historical Medical Museum indicates that exceptional resources have been available to the author in addition to those he himself could command. Further, it is obvious that the initiation and personality of Sir Henry S. Wellcome, who contributes an interesting foreword, have been moving forces in the production of these two handsome volumes which contain, not merely a clear, concise, and complete historical review of Scottish medicine, but also establish themselves as the standard work on this subject.

The period covered is a very wide one. It goes back to the stone and bronze ages, during which we learn, from photographs of remains discovered in Scotland, that trephining and other complicated operations were carried out at that remote time by means of crude flint and metal instruments.

Early monastic and medieval medicine, with its interesting admixtures of folklore, herbalism, and superstition, affords much interesting reading and the opportunity of reproducing curious Gaelic medical manuscripts, in colour and otherwise. The translations of these early medical writings display their quaintness. For example, we read

"*Margarita, i.e.* a pearl. This stone is cold dry, and is found in a shell. And it grows in this way. When the shell opens it takes in its fill of poisonous dew, closes around it, and turns it into stone. The pearl that has a natural hollow in it is best, if also white. It is comforting in heart affections, and is put in electuaries. And if you wish to make the pearl white, give it to a pet pigeon to eat, and let it be left in its crop (stomach) for three or four hours. Then cut up the bird and remove the stone, and it will be pure, clear, brilliant thereafter."

In the fifteenth and early sixteenth centuries public health regulations for the prevention of infectious disease were instituted, and it is recorded as a result that plague was stamped out of Scotland in 1648.

Reference is made to the interest taken by James IV of Scotland in alchemy, in the pursuit of which he was assisted by a physician named John Damian. This leads to a description of the transition from alchemists to chemists.

So the story proceeds, for the maintained interest justifies the use of the word 'story' for this fascinating history. We read of the origins of the Scottish Colleges of Physicians and Surgeons, and of the universities and medical schools which established the reputation of Edinburgh, Glasgow, and other Scottish cities throughout the world. We read about the foibles of the early professors, which are illustrated by anecdotes and contemporary caricatures, and finally we have placed before us, in picture and story, a panorama of Scottish pioneers in medicine and the allied sciences.

The "History of Scottish Medicine" will interest everyone who loves history or science. To the student it will be doubly attractive, because its charm of style is supplemented by a business-like method which provides very full references to all sources of information, and an index which is an example of what this part of a work of reference should be.

#### A Mycological Classic

*Selecta Fungorum Carpologia of the Brothers L. R. and C. Tulasne*. Translated into English by W. B. Grove. Edited by Prof. A. H. Reginald Buller and Dr. C. L. Shear. Vol. 1. Pp. xxx + xxv + 247 + 5 plates. Vol. 2. Pp. xxiii + 302 + 34 plates. Vol. 3. Pp. xviii + 206 + 22 plates. (Oxford: Clarendon Press, London: Oxford University Press, 1931.) 126s. net.

THE foundations of knowledge of the fungi as living plants were securely laid in the sixth decade of the last century by the work of Anton de Bary and the two Tulasne brothers. That of de Bary has had the widest influence, aided materially by the English translation, the "Comparative Morphology and Biology of the Fungi, Mycetozoa and Bacteria", which has been the standard textbook of English-speaking mycologists for more than forty years. The great folio volumes in Latin of the Tulasnes have been, no doubt, dipped into by many an eager young mycologist, and their magnificent plates were widely used, but the Latin is not easy and few can have had the courage to attempt systematic reading of it.

At last, after seventy years, the three folios of the *magnum opus* of the brothers, the "Selecta Fungorum Carpologia", have been translated into

English in a form and style which challenge comparison with the originals, and are a worthy monument to English learning and English printing. The production of these sumptuous volumes was made possible by the financial support of some half-dozen American and British patrons of science, and in Mr W B Grove a translator was found who combines in an unusual degree Latin scholarship with mycological knowledge. The Oxford University Press has rivalled the original production of the Imperial Press at Paris and faithfully reproduced the work in the almost lost grand manner of typography and in the technically excellent collotype copies of the famous engraved plates. The editors, Prof A H R Buller of the University of Manitoba and Dr C L Shear of Washington, may well feel satisfied with the result.

Louis René, the skilled microscopist and deeply learned student of fungi, and Charles, the superb draughtsman and scarcely less ardent mycologist, worked, as they lived, in closest harmony. When the first volume of the "Carpologia" was published in 1861, spontaneous generation was still an open question, the fungi being, of all plants, those that were held by some of the famous men of science to illustrate best the origin of organisms from the disordered juices or putrefying elements of the matrix in which they appeared. It was the aim of the brothers to show that every fungus arose from a pre-existing one, reproduced by seed-like spores, however much polymorphism might make it difficult to follow the process. They were the first to study development and to trace through different stages the gradual course of evolution that is characteristic of many fungi. This volume may be considered to have established finally the claims of the fungi to be regarded as separate living plants, propagating their like. It is enriched by a wealth of notes, covering almost the whole range of the fungi and bearing witness to the extensive knowledge of these organisms possessed by the authors.

In the closing pages of the first volume and in the two following ones, more than 200 species of Ascomycetes are described, nearly 150 of these being figured, including all those that were regarded as new to science. Most of the descriptions are based on close field collecting and repeated observation of the association or succession in Nature of the different forms that were linked into the one life-history, supplemented by the excellent microscopic preparations of one brother and the artistic ability in depicting them of the other. Methods of growing the fungi in artificial culture were not then available and the complicated succession of

spore forms was perforce followed mainly in the field. It is natural that some of the life-histories have not stood the test of accurate proof afforded by pure culture work, and it is perhaps a reproach to mycology that others must still be classed as not proven. But it is astonishing how many were rightly interpreted and how little escaped these indefatigable workers. The discussion on spermatia and the obvious disappointment of the authors that they were unable to assign to them with certainty the sexual functions that they believed them to possess, is interesting reading after seventy years, when these functions have but recently been established in the rusts and are still only suspected in other fungi.

The "Carpologia" may well be regarded as, in the words of its translator, "one of the supreme triumphs of science." Observers as minute and accurate, artists as dexterous, engravers as wonderful, printing as superb, have indeed existed—but nowhere else can they be found in such a perfect combination. This is high praise, but who shall say that it is not justified?

#### Photographic Methods

- (1) *Photography its Principles and Practice* By C B Neblette. Second edition. Pp xxii + 615 (London: Chapman and Hall, Ltd, 1931) 30s net.
- (2) *Wissenschaftliche Photographie eine Einführung in Theorie und Praxis* Von Prof Dr E v Angerer. Pp viii + 185 (Leipzig: Akademische Verlagsgesellschaft m b H, 1931) 12 80 gold marks.
- (3) *The Technique of Colour Photography* By Frank R Newens (Blackie's "Technique" Series) Pp x + 101 + 6 plates (London, Glasgow and Bombay: Blackie and Son, Ltd, 1931) 4s 6d net.
- (4) *Photographic Amusements including Tricks and Unusual or Novel Effects obtainable with the Camera* By Frank R Fraprie and Walter E Woodbury. Tenth edition revised and enlarged. Pp. viii + 271 (London: Chapman and Hall, Ltd, 1931) 15s net.
- (5) *The Amateur Cinematographer's Handbook on Movie Making* By Robert Dykes. Pp 109 + xix (London: British Periodicals, Ltd, n d) Paper, 2s, cloth, 3s 6d.

IT is a regrettable fact that good textbooks of photography are rare. The first two of the five books in the group under review are, therefore, specially welcome.

(1) Mr Nebllette has been a teacher of photography for some years. His book is already well known and is considered to be one of the best elementary textbooks of photography available in English. It sets out and explains in a straightforward way the principal photographic processes and apparatus. It is therefore invaluable as a reference book. The book also contains a considerable amount of theoretical discussion. The chapters on sensitometry and the theory of development contain an account of the contributions made by Hurter and Driffeld to our knowledge of the behaviour of photographic materials. Attention is directed in this new edition to the unsuitability of the Hurter and Driffeld (H and D) method of computing 'speeds', and the reader is referred to various recent papers in which the difficult problem of the interpretation of sensitometric data is discussed more fully. This method is employed throughout the book. The main principles are stated, as a rule, fairly clearly, and an inquiring student is then referred to a list of more detailed books and papers on special points. Indeed, the book is very well documented, each chapter has a list of related general works, and in the appendix there is a forty-page bibliography of most of the important scientific papers on photographic subjects. In addition, there is a good author and subject index.

Some of the theoretical discussions do not, however, reach a very high level. The chapter on photographic emulsions is confusing. The discussion of the chemical mechanism of development is marred by a few paragraphs which are incomprehensible. We are told, for example, that "The ionised hydrochinon loses two anions which unite with and neutralise the two silver cations forming metallic silver, the two oxygen ions combine to form quinone and the bromine anion unites with the sodium cation to form sodium bromide" (p 256).

(2) Prof. von Angerer gives us also an excellent introductory textbook of photographic science. It is not really an elementary textbook, the net has been cast far wider than for Mr Nebllette's book, and in a small space a vast collection of facts about photographic materials and apparatus is brought together and discussed in a way which is admirable. The use of photographic methods as aids to research, for example, in spectroscopy, receives considerable attention. In a very considerable degree these two books are complementary.

The remaining three books deal in a practical way with their special branches of photography.

(3) That of Mr Newens is a very clear and pleasantly written account of colour photography

as it may be practised by the amateur. The various methods are thoroughly explained by coloured diagrams, and the working instructions are plainly set out. No attempt is made to explain, in anything but the barest qualitative way, the theory of colour photography.

(4) Mr Fraprie has brought up to date an old book "Photographic Amusements" has now reached its tenth edition. It was first published in 1896. As its name implies, it describes a variety of photographic tricks. Some of these are, of course, trivial enough, just suitable to amuse a child, but many useful workshop methods are described. Notable among the latter is the process known as 'player type', by which full-size copies of drawings may be made without distortion. Of the newer amusements included in this edition is that of trick cinematography, a field of surpassing opportunity. The book affords ample evidence that photographs are not always truthful.

(5) Mr Dykes has chosen a rather misleading name for his book. Anyone who imagines that the "Amateur Cinematographer's Handbook" is a handbook of the conventional type, with neatly tabulated, easily found information, will be disappointed. It is merely a somewhat rambling, though quite interesting talk about amateur 'movie' making. There is little attempt at arrangement, and the descriptions of apparatus are not very clear.

S O R

### Short Reviews

*The Fauna of British India, including Ceylon and Burma* (Published under the Authority of the Secretary of State for India in Council) Edited by Lieut.-Col J Stephenson. *Cestoda*. Vol. 2. By Dr T Southwell. Pp ix + 262. (London: Taylor and Francis, 1930) 15s.

In this volume, Dr Southwell gives a systematic account of the super-family Tæmoidea (or Cyclophyllidea), which comprises a dozen families, including several of great importance, as they contain parasites of man and of domestic animals. The author regards as untenable the subdivision of the genus *Tænia*, as suggested by Hall, into three genera—*Tænia*, *Multiceps*, and *Echinococcus*, based chiefly on larval characters—pointing out that when a diagnosis is required of a worm passed, for example, by a dog, no information is available whether the larval form is a cysticercus or a cœnurus. He holds that the identification should be possible on the morphological characters of the adult worm. The genus *Tænia* is accepted in its widest sense, and, owing to the impossibility of devising a satisfactory key, a table showing the principal characters of the known species is given.

The cœnurus of *T. multiceps* is well known to

occur in the brain of sheep, and the cœnurus of *T. serialis* in the subcutaneous tissues of the rabbit. Dr. Southwell directs attention to the discovery by Gaiger (1907) of a cœnurus in the connective tissue of the goat, which was held to be that of *T. serialis* (later named by Hall *T. gaigeri*), and the finding by Dey (1909) of the same stage in the connective tissue and also in the brain of the goat in India. He regards the species *multiceps*, and these others, *serialis* and *gaigeri*, as very closely related, and possibly identical, and suggests that the goat provides conditions in both brain and connective tissue for the development of the larval form, whereas in the sheep and in the rabbit the larval form develops respectively in only one of the sites.

For most of the species, Dr. Southwell not only states the principal structural characters but also notes the mode of infection of the host and the site of the larval form in the intermediate host. A classified list of Cestodes from India, with their hosts, a classified list of the hosts with their Cestodes, and an adequate systematic index conclude this useful volume. The illustrations, with the exception of the photograph on p. 27, are clear and adequately lettered.

*Fourth Congress of the Universities of the Empire, 1931. Report of Proceedings.* Published for the Universities Bureau of the British Empire. Pp. vii + 260. (London: G. Bell and Sons, Ltd., 1931.) 21s. net.

In this volume a number of current university problems are clearly set out and competently discussed with a wealth of illustration and argument from many widely differing points of view. Organised as it was, in the light of experience gained in previous similar congresses, ample opportunities for informal interchanges of views and experiences being provided at London and elsewhere during the week preceding the scheduled meetings which took place at Edinburgh on July 7-10, the fourth quinquennial gathering of representatives of seats of learning in all parts of the Empire was an ideal forum for the discussion of such matters.

The first subject of discussion was the university graduate in commerce and industry. This was introduced by Sir Robert Waley Cohen, of Cambridge, who justified its prominent place in the agenda by reference to the world-wide economic revolution now in progress necessitating the re-laying of the very foundations of commerce and industry, and the consequent need, in this field, of men of high character and trained intellect. In subsequent sessions the Congress dealt with the conditions of admission to universities, facilities for overseas students in British universities, general honours degrees, the Ph.D. and other post-graduate degrees, and post-graduate study in medicine and surgery.

The inaugural addresses, with which each day's proceedings opened, ranged over a wider field, and of one (Lord Meston's "A Layman looks at the University") the chairman observed that the author had put his finger on all the major problems which those responsible for the conduct of university teaching have felt to be pressing upon them in

the last few years. Although, naturally, 'laymen' took but a small part in the proceedings, the record as a whole is eminently readable and there are few pages that have no appeal outside university circles.

*Úvod do Radioaktivity.* Napsal Dr. F. Běhounek a Prof. Dr. J. Heyrovský. Pp. 116. (Praha: Jednoty Čs. Matematiků a Fysiků, 1931.) 24 Kč.

It was in pitchblende from the mines of Jáchymov (St. Joachimsthal) in Bohemia that Prof. and Mme. Curie first discovered radium. The ores from these mines now yield radium preparations representing two to four grams of the pure element annually. In spite of the interest in the subject, the present volume is the first book by Czech men of science on radioactivity. It deals with the discovery and phenomena of radioactivity, the preparation of radium products and their physiological action, geophysics, cosmic radioactivity, and the technique followed at the Czech mines and extraction plant and at the Prague Radiological Institute.

Prof. Běhounek accompanied General Nobile's expeditions to the north pole in 1926 and 1928, and his experiments on radioactivity of the atmosphere in the arctic and at high altitudes is embodied in the chapters on geophysics and cosmic radioactivity. Prof. Heyrovský is best known for his polarographic researches with the dropping mercury cathode, and this method has found application in the examination of radium-barium salt mixtures.

The authors have introduced several unusual features in their treatment of the subject. Thus, stress is laid upon the experimental aspect of radioactivity and theoretical considerations are dismissed very briefly. The general reader will be particularly interested in the account and photographs of the methods of extracting radium from the large quantities of ores needed, and in the procedure in studying the use of this element in medical treatment.

J. G. F. D.

*The Annual Register: a Review of Public Events at Home and Abroad for the Year 1931.* Edited by Dr. M. Epstein. Pp. xv + 316 + 169. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 30s. net.

THE history of the world, which it is the main function of this annual volume to place on record, has gone through a troubled year, with many changes and upheavals in the old order of things, but the "Annual Register" maintains its old form and arrangement. British and Imperial history occupy, in a most readable narrative, about one-third of the book. Then comes the history of foreign States in about the same compass, followed by the usual chronicle of events, surveys of literature, art, drama, science, finance, and commerce, and finally the short biographies of eminent men and women in the year's obituary. The Constitution of the new Spanish Republic is given in full. The survey of the year's science occupies about eleven pages, divided between the biological and physical sciences. It is noteworthy that this work of reference has now reached its hundred and seventy-third year of issue.



## The Hereditary Transmission of Acquired Characters\*

By Prof J B S HALDANE, F R S

"Enfin les efforts faits par le besoin pour obtenir des facultés nouvelles, se trouvant aidés du concours des circonstances favorables, créent avec le temps les organes nouveaux qui sont propres à ces facultés, et qu'ensuite un long emploi développe"

LAMARCK, *Discours d'ouverture de l'an XI*

"Nil ideo quoniam natumst in corpore ut uti Possemus, sed quod natumst id procreat usum"

LUCRETIUS, *De Rerum Natura*, IV 834

THE tendency of men, animals, and plants to resemble their parents has been known for some thousands of years, although it is only since the time of Mendel that it has been realised that this is only half, and not necessarily the most important half, of genetics. Given that principle, men naturally argued somewhat as follows. A fat pig generally has fatter children than a thin pig. If we fatten up this thin pig, his children will be fat. This is a straightforward argument, as good as most used in politics. But it is, as we shall see, fallacious. The difference between a fat and a thin pig may be due to two causes. The two pigs may be of the same breed, but have had a different diet, or they may be of different breeds, but have had the same diet. Finally, of course, both causes of difference, external and internal, may be operating. Now, those who, like Lamarck, believe in the hereditary transmission of all acquired characters, take the view that if fatness has been produced for some generations by the external cause of diet, it will later go on being produced by internal causes when the external cause is removed. There is nothing impossible in this supposition, but if we put it that way, its *a priori* probability appears less.

As the result of experimental work, some of which I shall summarise, the majority of geneticists take the view that characters acquired as the result of external influences are rarely inherited, so rarely that the exceptions are of little importance either for the explanation of evolution or the practical problems of the breeder or eugenicist.

Last year Prof E W MacBride restated the case for Lamarckism in a discourse under the title of "Habit, the Driving Factor of Evolution"†. Prof MacBride's contributions to the science of embryology have been most distinguished, and his apparently heretical views on the historical process of evolution, for example, concerning the descent of the vertebrates from a common stock with the echinoderms, have been confirmed by subsequent work. But just as the best of historians may not be the best judge of the politics and economics of his own day, so an eminent student of the history of evolution may conceivably be mistaken as to its causes. These must be decided on by observing the

changes which actually occur in living organisms under controlled conditions.

I shall begin by giving an example of one of the rather rare cases where an acquired character is unquestionably inherited. If we cut off the growing point of a young tomato plant it produces new shoots. A few of these regenerated shoots are somewhat abnormal. The leaves are larger, and if these shoots are cut off and rooted, a new race of tomato is produced. It differs from the original stock in the following respects. The leaves are thicker, less dissected, and have more anthocyanin. The fruits are smaller but more numerous. The whole *tempo* of the plant is slower. It does not start growth so quickly, but continues for a longer time, and finally reaches a larger size‡. What is more, not only do the abnormal plants transmit the character by vegetative propagation, but if their flowers are self-fertilised the seedlings resemble the abnormal parents. They can only be crossed with the original type with great difficulty, and the hybrids are extremely sterile.

Now, if we examine a dividing nucleus of the ordinary tomato, we find 24 chromosomes. The abnormal type has 48, or double this number. Such plants are called tetraploids, because they have four similar sets of chromosomes, instead of two as in normal tomatoes. We know that the chromosomes are responsible for most, if not all, of the heritable differences between different tomatoes. By our injury we have provoked a stable and self-perpetuating rearrangement of the physical basis of heredity. Where this is possible, acquired characters are inherited.

Induced tetraploidy has doubtless been of some importance in plant evolution, and possibly in animal evolution. But it does not produce very striking changes. Moreover, there is no suggestion that they are adaptive, that is to say, that the tetraploid plants are better off than the diploid in any way, in particular, they do not appear to resist mechanical injury any better. The importance of the Lamarckian hypothesis for evolution lies in the possibility that adaptive changes, such as undoubtedly occur in the life of an individual, are handed on to its offspring.

It is also worth noting that in this case the change is only found in the descendants of a particular cell the nucleus of which has failed to divide. It is not transmitted to other parts of the plant. Now, in the higher animals the cells which will form the future germ cells are cut off at an early stage from the rest of the body, and are carefully shielded from change by a series of processes regulating the temperature and chemical composition of the blood going to them. This argument appealed to Weismann. But it does not apply to the higher plants, where the cells of any growing point may give rise to germ cells. In any event, it is not a very sound

\* Friday evening discourse delivered at the Royal Institution on April 22. (Since the lecture was written, I find that Prof W E Agar has covered much of the same ground and anticipated many of my conclusions in the Braisford Robertson memorial volume of the *Australian Journal of Experimental Biology* (1932) — J B S H.)  
† NATURE, 127, 933, June 20, 1931.

‡ I must thank Dr Sansome for permission to quote his unpublished observations.

argument, even in higher animals, as the environment of the germ cells is not absolutely constant

I will now cap my positive example with some negative ones. If plants or animals are inbred for many generations, they approximate to what is called a pure line. Within any such line, differences are not inherited. All members have the same hereditary make-up. The differences between them are due to environment, and are not handed on to the offspring, as appears from Table I (from Johanssen). The progeny of the heaviest beans chosen within the line were no heavier than those of the lightest. Within such a line neither Lamarckian transformation nor Darwinian selection produces any measurable effect.

Exactly the same results were obtained by Wright within pure lines of guinea-pigs. The guinea-pigs born of old mothers had more white in their coats and fewer toes than the average, but their offspring did not resemble them in these respects. Clearly a transformation of a pure line would be a much more notable achievement than

be called an instinct, a tropism, or a reflex, according to taste. Now, it is a well-known fact that cave-dwelling animals are often blind and colourless. Payne bred *Drosophila* in darkness for 69 generations. After ten generations he believed that he had diminished their tendency to fly towards a light. But after 69 generations there was no change in colour or structure, and the effect on behaviour, as measured on 1000 flies, was negligible. The flies were given ten minutes or more to adapt themselves to light, and were then placed at one end of a dark tube nine inches long, the other end of which was illuminated. About a quarter of the flies did not react within a minute, and were 'counted out'. This proportion was not altered by breeding in darkness. On the other hand, the speed of reaction was very slightly increased. There is certainly no suggestion that the flies had lost the tendency to move towards light through disuse.

The alternative explanation of blindness in cave-dwellers is that animals suffering from hereditary blindness have no tendency to leave a cave, and hence their descendants populate it. It is interesting that a race of the same fly, selected on account of a peculiar body colour, does not move towards light, and might therefore remain in a cave where normal flies would tend to leave it.

We now turn to some of the experiments on which the neo-Lamarckian

TABLE I

| Year | No. of Beans | Mean Weight of Parents |       |            | Mean Weight of Offspring |              |               |
|------|--------------|------------------------|-------|------------|--------------------------|--------------|---------------|
|      |              | Light                  | Heavy | Difference | Parent Light             | Parent Heavy | Difference    |
| 1902 | 145          | 600                    | 700   | 100        | 631.5 ± 10.2             | 648.5 ± 7.6  | + 17.0 ± 12.7 |
| 1903 | 252          | 550                    | 800   | 250        | 751.9 ± 10.1             | 708.8 ± 8.9  | - 43.1 ± 13.5 |
| 1904 | 711          | 500                    | 870   | 370        | 545.9 ± 4.4              | 566.8 ± 3.6  | + 20.9 ± 5.7  |
| 1905 | 654          | 430                    | 730   | 300        | 635.5 ± 5.6              | 636.4 ± 4.1  | + 0.9 ± 6.9   |
| 1906 | 384          | 460                    | 840   | 380        | 743.8 ± 8.1              | 730.0 ± 7.2  | - 13.8 ± 10.8 |
| 1907 | 379          | 560                    | 810   | 250        | 690.7 ± 7.9              | 676.6 ± 7.5  | - 14.1 ± 10.9 |

After Johanssen. Weights in milligrammes

anything done in a mixed population, because in the latter case selection is known to be effective, and it is up to the Lamarckian to prove that he has not exercised selection.

The two experiments which have lasted the greatest number of generations have both been performed on quickly breeding arthropods. Agar bred the little water-fleas *Simocephalus* and *Daphnia* for 101 and 79 generations respectively. These animals reproduce by parthenogenesis, under the conditions of Agar's experiment, the life-cycle being completed in a week or a little longer. They swim by means of their second antennæ. If one branch of these is cut off when the animal hatches, the feather-like setæ are usually, though not always, regenerated. It might have been expected that after a hundred generations the progeny of the operated animals might have shown an increased aptitude for regeneration. This was not the case. If anything, they regenerated very slightly worse than the controls, but the difference was not significant. Agar also tried the effect of selecting those animals which regenerated best. He got no effect at the end of forty generations. This was to be expected, as he worked with a clone, within which, as within a pure line, there are no heritable differences.

It might be hoped that better effects would be obtained where the character studied was of a more psychological kind. The fly *Drosophila melanogaster* generally moves towards a light. This may

ian case is based. Except those of McDougall, which are in a class by themselves, none of these has been conducted on approximately pure lines. Since we know that in a mixed population selection is effective, we shall see whether this cannot account for the observed changes. I will therefore consider the experiments cited by Prof. MacBride.

Durken worked with *Pieris brassicæ*, the cabbage white butterfly, the pupæ of which become green when the larvæ are kept under yellow, orange, or green glass. This discovery was not made, as MacBride states, by Durken, but by Wood in 1867, and very fully described by Poulton in 1887. In a typical experiment of Durken's, 4 per cent of the pupæ reared in normal light were green, as were 63 per cent of those reared in orange light. Only the moths emerging from the green pupæ were bred from, and these gave 98 per cent green when the caterpillars were kept in orange light, and 48 per cent in normal daylight. Now, one cannot prove that Durken had not observed the transmission of the effect of the light. But there is no evidence for this hypothesis. He had selected the green fraction of the pupæ, and naturally enough he got more greens in the next generation. Selection is generally quite effective except within a pure line, and there is not a shadow of evidence that Durken observed anything but the effects of selection.

For comparison, let us study a more scientifically

conducted experiment of the same kind, namely, the late Dr Bateson's experiment (posthumously published from his notes by Sir Daniel Hall) on 'bolting' in sugar beets and mangolds. On an average, about 5 per cent of the plants in a field of sugar beets bolt, that is to say, they throw up a stem and set seed during their first year, so that the roots are denuded of sugar and worthless. The rest behave as biennials. Mangolds show a similar phenomenon. It was known that early sowing promotes bolting. Now, Bateson, we may assume, started out with the hypothesis that bolting may be due to internal or external causes. So, instead of sowing mangolds in the open in April, he sowed them under glass in December or January, and planted them out in April. Thus any plant with an inherent tendency to bolt was given the fullest opportunity to do so. Sutton's Prize Globe mangold gave only 2 bolters out of 390 when sown in April. But when sown in December, 8 out of 19 bolted. The 11 non-bolters were used for seed, and none of their progeny bolted, even when sown in January. However, some seedlings from this family were subjected to severe temptation to bolt by sowing in December. Ten out of 136 (a much smaller proportion) bolted, but 213 of the progeny of the non-bolters refused to bolt when sown in January. In the case of sugar beet, the proportion of bolters was greater, and four generations were needed to eliminate the habit.

Bateson also made the converse experiment of trying to establish a race which always bolted. He did not get any appreciable increase of bolting when he selected the progeny of plants which had bolted as the result of early sowing. But by sowing seed of 12 plants out of 312 which had bolted when sown in April, he got 41 per cent of bolters. All this is entirely intelligible on the theory that bolting, in so far as it is an acquired character, is not inherited. If Durken had bred from the pupæ which refused to turn green even in orange light, he would no doubt have been able to eliminate the tendency to turn green, and if he had bred from those which turn green in ordinary light, he would presumably have obtained a more striking change in the next generation than was actually found. In order to prove the Lamarckian theory, it would be necessary either to start with a pure line or not to practise selection. Harrison, who worked with the turnip white butterfly, *Pieris rapæ*, which normally gives about 20 per cent of green pupæ, obtained more striking effects than Durken, as he only appears to have eliminated 7 per cent in one generation and 5 per cent in the next, and yet obtained 31 pupæ, all green, in normal daylight. While Harrison's case is thus far stronger than Durken's, it cannot be regarded as conclusive unless similar results are obtained without selection, either artificial or natural.

(To be continued)

### The Transport Problem in the United States

IN the century and a half which has elapsed since the American steam-boat pioneers, Fitch and Rumsey, began their experiments on the Delaware and Potomac rivers, transport in the United States has undergone many remarkable changes. From the work of those pioneers, in the course of years, came a magnificent fleet of river steamers, her engineers next gave the country the most extensive railway system in the world, while to-day the automobiles are so numerous that there is one for every five of the population, and transport by air is making rapid progress.

America is what it is largely because of its transport, without which its prairies would still be uncultivated and its mines unexploited. One of the landmarks in the history of that transport was May 10, 1869, when the last spike—a golden one—was driven in the railway which connected the Atlantic coast with the shores of the Pacific. On that occasion Philadelphia rang the old Liberty Bell, New York fired a hundred guns, Buffalo sang "The Star-Spangled Banner", and there was even a thanksgiving service in Trinity. There then seemed no end to the benefits to be gained from the railways, which to-day, by the irony of fate, are faced almost with bankruptcy.

Like our own railway system, that of the United States was built up entirely by private enterprise, and the present position of the railways is much the same as our own, some think it is somewhat more complex. What that position is, and what remedies

are suggested so that the railways can continue to fulfil their part in the national economy, are well stated in three contributions printed in the first issue for the current year of the *Proceedings of the American Philosophical Society*. The three papers are entitled (1) "The Railroad Situation. Some Suggestions as to the Way Out", (2) "A Way for the Railways to Keep Out after they are Out", and (3) "Co-ordination as a 'Way-out' of the Transportation Crisis"—the respective authors of which are Dr E. R. Johnson, Mr A. B. Johnson, and Mr G. L. Wilson. Of the three papers, the first is much the longest and gives a record of all the factors of the problem.

The United States railway system has some 250,000 miles of track, and the rolling stock includes about 67,000 locomotives, 57,000 passenger cars and 2,500,000 freight cars, the results of the development of a hundred years. The public roads include 3,000,000 miles of highways, of which some 700,000 miles are surfaced and about 128,000 miles are mainly of concrete. About 50,000 miles of streets are constructed or rebuilt annually, the expenditure on which reaches 2,000,000 dollars.

The number of automobiles of all kinds registered in the United States at the end of 1931 reached the astonishing figure of 23,042,840, the result of thirty years' development, and the number of companies engaged in freight traffic services runs into thousands. There are no complete statistics of the freight carried by motor vehicles, but not only are

fruit, vegetables, and live stock now conveyed by road, but also such things as coal and cotton. Of the 4,000,000 bales of cotton grown in Texas in 1930, 1,200,000 reached the ports by motor vehicles. But severe as is the inroad made on the freight traffic of the railroads by motor wagons, still more severe is that due to the private motor car and the motor buses. In 1920 the passenger earnings of American railroads were nearly 21 per cent of their total operating revenues, but in 1930 this figure had fallen to 13·8 per cent, and the showing for 1931 was even worse.

Added to the competition from the roads is that due to the carriers by water, for inland and coast-wise traffic. At the time the Panama Canal Act of 1912 was passed, several railroad companies had steamship lines on the Great Lakes and on the Pacific and Atlantic seaboard. By that Act, however, the companies were prohibited the use of the Canal for vessels owned by them, and other restrictions were placed on their maritime activities. At the close of the War, too, the United States possessed a large surplus of ships. Many of these were sold at a low figure and placed in service, while the Government itself entered the business of inland water transportation. The schemes have never paid their way, and, says Dr Johnson, "it is hard to justify the continuance of business operation on this basis by the Government in competition with private enterprise."

Traffic has not only been leaving the rails for the roads and waterways, but also for underground pipelines for distributing oil, natural gas, and gasoline. Formerly nearly all petroleum was sent by freight cars, and it involved a large tonnage. In 1929 only 4·5 per cent of the production was transported by rail. There are now 100,000 miles of crude oil pipelines in the United States, 65,000

miles of pipelines for the distribution of natural gas, and in 1931 there were also 3800 miles of gasoline pipelines. The rapid increase in the use of oil and gas has had a marked effect on the coal output of the country, and it has been estimated that in 1929 natural gas was substituted for about 77,500,000 tons of bituminous coal.

As to civil aviation in the United States, a recent return shows that American air transport companies now operate over routes with a total mileage of 51,000 miles, and the machines cover a total distance of 150,000 miles every twenty-four hours.

The problem of co-ordinating the great and varied transportation services of the United States, it will thus be seen, is a very complex one. It is one dealt with by Dr Johnson and Mr Wilson in their respective papers, both of which are worthy of the attention of the authorities in Great Britain. In reviewing the constructive and corrective measures required, Dr Johnson mentions the reduction of unprofitable train services, the operation by the railways of both passenger and freight motor services, a reduction in the competition among the railways themselves, the consolidation or grouping of the railways into a limited number of systems, the co-ordination of rail, road, water, and air services, and the regulation of all transport agencies by the Government, according to a sound and equitable national policy. What co-ordination means and how it can be effected is dealt with fully by Mr Wilson, who says "The trend towards co-ordination has proceeded to the point that we can predict that the great railroads, steamship companies, electric railways, and other specialised carriers will tend to become *transportation* companies offering a variety of transportation services to shippers and travellers that will supply the needs and fit the pocket-books of their patrons."

### Polar Lights\*

By Prof S CHAPMAN, F.R.S.

MANY of the principal facts concerning the polar lights, or aurora, have long been known. For example, John Dalton, the great chemist, who observed the lights carefully for many years, and thought deeply upon them, was well aware of their close connexion with the earth's magnetism as shown by their occurrence mainly in regions centred at the magnetic (rather than the geographical) poles, by their tendency to be extended in the direction transverse to the magnetic meridian, by the near agreement between the direction of auroral rays and the local direction of a freely poised magnetised needle, and by their parallelism, in time of occurrence and in intensity, with magnetic disturbances or storms. His ideas as to their height, on which Cavendish had made careful measurements, were also in general accord with modern determinations.

Modern observations of auroræ have advanced

our knowledge chiefly by establishing the height and situation with incontrovertible accuracy, by the methods of Størmer and his followers, and by the interpretation of the beautifully coloured auroral light, with the aid of the spectroscope and the great body of modern knowledge concerning atomic and molecular spectra.

Much remains to be done before the full fruits of the study of the auroral spectrum are garnered, but two main facts are established: a large part of the spectrum consists of bands due to singly ionised nitrogen molecules, while the famous green line, a standing challenge to spectroscopists for many decades, has been shown by McLennan to be emitted by neutral atomic oxygen, he, his colleagues, and others have traced the line in detail to its source in a particular transition occurring in the oxygen atom. Through the initiative of another active investigator of the auroral spectrum, Vegard, the Rockefeller Foundation has instituted an auroral observatory, maintained by the Norwegian Govern-

\* Substance of a lecture delivered at the annual general meeting of the British Science Guild on May 25

ment, at Tromsø, special attention will be devoted at this well-equipped and favourably situated observatory to this side of auroral research. A further remarkable observational discovery concerning the aurora, due to Størmer, is the recognition that the specially high auroræ, sometimes seen in the west after sunset, or in the east before sunrise, are in the part of the atmosphere, beyond the earth's shadow, still traversed by the sun's rays.

On the side of theory, the advances have been of comparatively recent date. Birkeland laid the foundations, by his speculations and experiments, on which Størmer has reared a great mathematical superstructure, developing the hypothesis that the aurora is due to electrically charged particles from the sun, these are deflected by the earth's magnetic field towards the polar regions, thus explaining the geographical incidence of auroræ. Størmer has deduced from this hypothesis the existence of the two auroral zones, and many other observed features of the aurora. But valuable and successful as the present theory is, it suffers, as Schuster indicated, from a great and deep-lying defect. Of the forces which guide the particles, the theory considers only the electromagnetic, whereas there will also be important electrostatic forces, which the theory ignores, the latter arise from the mutual influence of the particles, which must be partly positive and partly negative, in nearly equal numbers. A new theory must be built up, taking both sets of forces

into account, this promises to be exceptionally difficult, and only the merest beginning has yet been made. It is to be hoped that, in the future development of the work, much of the existing theory will find a place, being preserved in a larger structure, as has happened in many other branches of physical theory, but of this it is still too soon to judge.

At the present time we stand, it is hoped, on the eve of a further advance in the observation and theory of the aurora, and of its associated phenomenon, magnetic disturbance. Expeditions are now proceeding to take up their stations at many points in and near the arctic circle, in connexion with the new International Polar Year for scientific research on magnetism, auroræ, and meteorology. With modern instruments and methods, a great extension of the knowledge afforded by the first Polar Year, 1882-83, may confidently be looked for. The British magnetic and meteorological expedition, led by Mr J. M. Stagg, left for Fort Rae early in May, among other items of its programme is included the determination of auroral heights, from two stations connected by cable or radio. Another British expedition, under Prof E. V. Appleton, will leave shortly for Tromsø, to determine, by radio methods, the amount, distribution, and changes of ionisation near the auroral zone, its results should be of extraordinary interest and value for both auroral and magnetic research.

### Obituary

SIR THOMAS LEGGE, C.B.E.

THE death on May 7 of Sir Thomas Morrison Legge, late Senior Medical Inspector of Factories, deserves more than a formal note, for his official record in this capacity was coterminous with the chief reforms in factory hygiene which have occurred. In securing these he played an essential part.

Legge was the son of a distinguished Chinese scholar. After taking his degree with honours at Oxford, he investigated public health conditions in European countries, and described their municipal administration in a volume which may still be referred to with advantage. After serving as secretary of the Royal Commission on Tuberculosis, 1896-98, he worked in public health in Brighton, and afterwards was appointed the first Medical Inspector of Factories and Workshops, a post held by him for nearly thirty years. In this capacity he undertook many important investigations, among others, the relation of cataract to the glare in a glass-blowing factory, the causation of nystagmus, and the origin of various other industrial conditions, in which questions of compensation arose.

Legge gave the Milroy lectures before the Royal College of Physicians on anthrax, and some years later his distinction in industrial medicine was indicated by his receiving from the same College the Bisset Hawkins medal as a pioneer in public health. He was instrumental in securing the

establishment of an official disinfecting station for wool coming from anthrax-infected countries.

Legge's life-work was largely concerned with investigations of industrial lead poisoning and with securing regulations against these risks, and the record of steadily diminishing incidence of cases of lead poisoning year by year is eloquent testimony to the success of his work and that of his colleagues. In 1921 at Geneva thirty countries, including Great Britain, had agreed to a draft Convention, under which it was intended to prohibit the use of lead paint for internal painting. In 1927 Great Britain, however, while regulating the employment of lead paint, did not make its prohibition absolute, and Legge resigned his post at the Home Office in protest, a year or two before his appointment lapsed by flux of time.

Before and after his retirement Legge did valuable work in promoting industrial hygiene, by lecturing on his subject in America and in Great Britain. He held very strongly that for medical students industrial hygiene and poisoning were left almost entirely out of the medical curriculum. He was also insistent that the psychology of the worker should be more fully studied and considered.

Throughout his life, Legge took great interest in the artistic side of the worker's work, and outside his daily work he delighted in discovering examples of old church and other stained glass. In this subject he was, indeed, an authority, and had at one time a valuable collection.

Legge's outstanding personal characteristics were modesty and unyielding integrity. He was concerned with his work, not with credit that might come from it, and it is most satisfactory, therefore, that we can now recall with gratitude his extremely important contribution to the welfare of industrial workers in Britain and in other countries

A N

#### PROF OTTO FISCHER

WE regret to record the death on April 4, after a prolonged illness, of Prof Otto Fischer, who was associated for many years with his more famous cousin, the late Emil Fischer. From the *Chemiker-Zeitung* we learn that Otto Fischer was born in 1852 at Euskirchen, near Cologne. On leaving school, he studied for a short time with Kekulé at Bonn before proceeding to Strassburg, where he began his researches on the synthesis of hydrocarbons under Adolph von Baeyer, and where Emil had already begun his career. After graduating in 1874, Otto proceeded to Charlottenburg to work with Liebermann, but two years later he rejoined von Baeyer, who had in the meantime been called to Munich. In Munich the cousins Fischer worked upon the preparation of organic hydrazines and upon the dyestuffs of the triphenylmethane group. In 1882, Emil was appointed to the chair at Erlangen, but his health broke down and, in 1884, Otto was sent to act as his substitute. In the following year, Emil accepted the chair at Würzburg, and Otto

was appointed to succeed him at Erlangen. This post he held until his retirement in 1925.

In conjunction with his assistants and students, Otto Fischer published a considerable number of papers on organic chemistry—his favourite field of research being dyestuffs. In conjunction with Dr E. Hepp, of the Hochster Farbwerke, he investigated nitrosamines and nitroso-bases, the reactions of the iminazol-group, the safranines, indulines, and fluorindines. Later he worked upon the photosensitising dyestuffs of the cyanin group. He also investigated derivatives of pyridine, quinoline, and anthracene, and he discovered the drug kairine.

#### WE regret to announce the following deaths

Prof Fritz Drevermann, professor of palæontology in the University of Frankfurt-on-Main, and editor of the *Palaontologischen Zeitschrift*, on March 16, aged fifty-seven years.

Dr Carl Leo Mees, president emeritus of the Rose Polytechnic Institute at Terre Haute, Indiana, who was twice vice-president of Section A of the American Association for the Advancement of Science, on April 20, aged seventy-eight years.

Dr Roland Thaxter, emeritus professor of cryptogamic botany at Harvard University, and honorary curator of the Farlow Herbarium, who was a member of the National Academy of Sciences and foreign member of the Linnean Society of London, on April 22, aged 73 years.

### News and Views

#### Sir Henry Wellcome, F R S

At a meeting of the Royal Society on May 26, Sir Henry Wellcome was elected a fellow of the Society under Statute 12, which provides for the recommendation by the Council for election of "persons, who either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the Society." Sir Henry, who was knighted last January for his public services, has been a generous and frequent benefactor of scientific research. In 1899 he founded the Wellcome Tropical Research Laboratories in Khartoum, where the late Sir Andrew Balfour worked for many years; he established in England in 1913 his Bureau for Scientific Research and Historical Medical Museum, and in 1914 the Museum of Medical Science, including Tropical Medicine and Hygiene; in 1920 he founded the Wellcome Entomological Field Laboratory. Last year, Lord Moynihan laid the corner-stone of the Wellcome Research Institution, where the Historical Medical Museum and Museum of Medical Science will be brought together under one roof, and facilities provided for research in medical zoology, parasitology, entomology, tropical medicine and hygiene—the corner-stone, as Lord Moynihan remarked, of a long life's work. Sir Henry Wellcome's election to the Royal Society is a fitting acknowledgment of one who has done as much as anyone in Great Britain to promote the advance of the science and art of medicine.

#### Scope and Needs of Medical Research

SIR WALTER MORLEY FLETCHER delivered the Friday evening discourse at the Royal Institution on May 27, taking as his subject "The Scope and Needs of Medical Research." He pointed out that medical research covers immensely wide and varied fields of scientific activity, indefinitely wider than the important part of it which concerns the healing profession as such. Its scope has been defined for Parliamentary purposes as dealing with "the proper development and the right use of the human body in all conditions of activity and environment, as well as with its protection from disease and accident, and its repair." The development of the body includes the relatively new and rapidly growing studies of genetics on one hand, and of nutrition on the other. For the right use of the body we are concerned with personal hygiene as well as with the intricate group of problems belonging to industrial life. Here research is organised under the Industrial Health Research Board. Protection from disease covers the two great fields of preventive and of curative medicine. It deals with the genetic and nutritional control of disease, as well as with studies of infective disease at home and in the tropics. This infinitely varied field of work calls at every point for the intensive application of the primary sciences. This is well illustrated by the study of rickets, the detection of its dietetic basis, and the discovery of the relationship of light radiation to the fat-like substance



in the skin from which vitamin D is produced. Further development has involved intensive team work by physicists, chemists, and biologists, leading to the production of calciferol, the actual substance of vitamin D. This has not only made important contributions to organic chemistry as such, but also has brought improved practical powers to the medical administrator.

ANOTHER example of intensive work has been in the study of the so-called viruses, which cause widespread and often ruinous diseases in men, animals, and plants. New physical methods have been devised for their optical study and their separation and measurement by means of filters. The better study of these minute particles has not only an obvious utilitarian value, but also has extreme intellectual interest. They are units, apparently alive and reproductive, yet far smaller than any living cell which has hitherto been regarded as the minimal organisation capable of displaying life and reproduction. The whole story of medical research, whether viewed in its wide extent or followed to its intensive studies, illustrates the absurdity of the artificial boundaries that at present tend to separate the different sciences. In the schools, as Lord Chelmsford's Committee has reported, the cleverer boys are 'caught' for physics and chemistry, while the scholarship system, especially at Oxford and Cambridge, encourages a narrow specialisation which is, unfortunately, continued during undergraduate life. Most physicists and chemists proceed throughout school life and to a university degree without ever becoming acquainted with the interest of matter endowed with life. Many students lose opportunities they might have welcomed for fruitful work in the biological field, and the whole cause of medical progress suffers. Of students who proceed to medicine, many are again lost from the research field because of the great attraction offered by the natural human interest of professional work, or because of financial needs or desires.

#### Institute of Physics

LORD RUTHERFORD, presiding at the annual general meeting of the Institute of Physics, said that in the short time since its foundation, remarkable progress has been made towards the achievement of the original intentions of its founders. There has been a rapidly growing recognition of the importance of the physicist, not only in the academic world, but also in industry, and Lord Rutherford considers that the Institute can justly claim some of the credit for this. The properly trained physicist has the power to form his judgment by performing experiments, and if it be a subject where little is known, the cost of the investigation may only be a matter of a few shillings. It is very important that such an Institute should include every type of physicist among its members, and naturally to physicists in some of the sheltered posts, such as colleges and universities, it is not quite clear what particular advantages can be gained by joining the Institute, when they already have so many facilities at their own door. But taking a long view, Lord

Rutherford said, it is the duty of every physicist to join the Institute, wherever he may be, and so help on the recognition of the profession that he represents. He looks forward to the time when membership of the Institute will be considered a necessary professional qualification. The standing of the physicist in the scientific world, not only of to-day, but also of to-morrow, depends upon the support that the Institute receives.

#### Reading Rooms at the Institute of Physics

PRIOR to the annual general meeting, Lord Rutherford opened the new reading rooms at the Institute of Physics. Through the generosity of the Royal Commissioners for the Exhibition of 1851, some rooms have been allocated to the Institute for this purpose, and these have now been comfortably furnished. The Joint Library Committee set up by the Institute, the Physical Society, and the Optical Society has arranged that the libraries shall be combined for the mutual benefit of all, and thus a large number of periodicals and other books are already available for the use of members of the Institute and its participating societies. In addition, a limited number of textbooks and reference books are included in the library. In the course of his remarks, Lord Rutherford said that the opening of these rooms is another example of the co-operation of the participating societies through the Institute, which was one of the purposes for which the Institute was founded. Some of the rare old books belonging to the Physical and Optical Societies were open for inspection during the afternoon. It is hoped that authors and publishers will present suitably inscribed copies of their books, and in this way those whose attention has been directed to new books by the reviews published in the various journals of the Institute and its participating societies will have an opportunity of examining the books more carefully before procuring their own copies.

#### Game Animals of the British Empire

THE new gallery at the Natural History Museum, which is intended for the exhibition of whales, in replacement of the temporary building erected thirty-four years ago, was finished last autumn, but the economic crisis has interfered with the original plans, and, owing to lack of money, the Trustees have been unable to arrange for the renovation and removal of the large whale models. They decided that, in the circumstances, the gallery might usefully be employed for a comprehensive exhibit of the game animals of the British Empire. The open floor of the gallery has been divided into three parts, devoted to specimens from Africa, Indo-Malay, and Canada and Newfoundland respectively, the first of them being about as large as the other two combined, they themselves being equal. On the walls are suspended more than five hundred horns and skulls, some of the former being the 'record', that is, the largest known for the particular animal. Among the horns shown is the magnificent pair of the Indian buffalo which were included in the Sir Hans Sloane collection received in 1753 and are prominent among the limited number of

zoological specimens which have lasted to our day. With the exception of a white giraffe which has been lent by Rowland Ward, Ltd., all the specimens are drawn from the Museum collections. They show to much greater advantage in their present setting than crowded together in glazed cases in the Mammal Galleries. The exhibit, which has been arranged by Capt J. G. Dollman, was opened to the public on May 31.

#### New Botanical Collections

THE Department of Botany, British Museum (Natural History), has received some noteworthy additions during the last two months. His Majesty the King has placed on permanent loan a further collection of Nepal plants presented to him by His Highness the Maharaja of Nepal. The present consignment numbers 253 specimens, which were collected by Prof K. Sharma, Major L. Dhwoj, who was responsible for the previous collections, died during the expedition. The value of the collection is that it is from previously unexplored mountains. Another collection which will add to our knowledge of the floristics of the Himalayan region has been presented by Capt F. Kingdon-Ward. It consists of 1233 specimens, and is from the Upper Irrawaddy and the Burma-Tibet frontier. A valuable addition is the gift of the Boswell-Syme British Herbarium by Mr. Frederick J. Hanbury. This contains about 20,000 sheets, in fourteen mahogany cabinets, and will be kept as a separate collection. Boswell-Syme (1822-1888) was the editor of the third edition of "English Botany", and the specimens on which his remarkably accurate descriptions were based are in the collection. The herbarium was purchased by Mr. Hanbury on Boswell-Syme's death, and is in excellent condition. British botanists will now be free to consult the remarkably long series of species which are rarely well represented in modern herbaria. Mr. A. Vernay has presented a set of plants obtained on the Vernay-Lang expedition to the Kalahari desert. This area is very poor floristically, and the 264 species, including twenty type gatherings, are consequently of value in extending our knowledge of distribution.

#### Acquisitions at the Natural History Museum

AMONG the chief recent acquisitions in the Zoological Department of the British Museum (Natural History) are 60 mammals and 590 birds obtained by the Vernay-Lang Expedition to the Kalahari Desert, presented by Mr. A. S. Vernay, the mammals include specimens of 11 forms recently described as being new to science by Mr. Austin Roberts of the Transvaal Museum. Another important gift received from Mr. Vernay is a collection of 184 mammals, 29 reptiles, 34 fishes, and 500 butterflies obtained by Capt Beresford Holloway, who accompanied Mr. Vernay on his recent expedition to the Malay Peninsula. This collection comprises many rare species, including a specimen of the rare *Rhinoceros sondaicus*, which is now being mounted, at the expense of the donor, for exhibition in the Museum. Purchases for the Department of Geology include a specimen of

the teeth of an extinct shark, *Edestus*, from Devonian rocks of Rhenish Prussia. The median teeth of *Edestus*, instead of falling away after use as in all other sharks, remained attached to their successors, forming in the course of time an external dental spiral which must have hung over the point of the jaws and sometimes contained no less than 150 teeth. Prof. G. Vibert Douglas has collected and presented to the Department of Minerals a large series of rocks illustrating the geology and mineralisation of several mines in the 'copper belt' of Northern Rhodesia and Katanga. Samples of volcanic dust which fell after the recent eruptions (April 11-12) in the Andes have been presented by the *Times* Publishing Co. and by Messrs H. W. Nelson, Ltd.

#### British Science Guild

AT the annual meeting of the British Science Guild held on May 25, Sir Samuel Hoare was re-elected president for the ensuing year, and affirmed his faith in the aims of the Guild. The annual report shows a year of useful work. Perhaps its most interesting feature is the attempt which the Guild is making, in conjunction with the Association of Scientific Workers, to provide an adequate channel for bringing before Parliament the views of scientific men. A Science Advisory Council is being set up, and it is intended that this Council shall be in some sense comparable with the Federation of British Industries, in the sense that it shall be the liaison body for providing contact with Parliament in connexion with scientific and technical matters coming before the House. The success of the projected Council will, of course, depend on the degree in which it enjoys the co-operation of scientific and technical societies, a number of which have already agreed to participate. The extent of its activities, however, will be mainly determined by that of the funds placed at its disposal, and in this aspect the matter has yet to be put on a satisfactory basis.

#### Research and Industry

IN a recent article in the *Journal of the Textile Institute*, on "Cotton Research and Academic Physics", Dr. F. T. Peirce points out that the tendency of men of science to get into ruts of thought is partly responsible for the tardiness of the academic mind to appreciate and interpret the problems of technology in a way that is essential for the interpenetration of science and industry. On the other hand, while as one consequence of specialisation every research worker is accustomed in his reading to slur over matter which he cannot or need not understand, the industrialist is apt to be offended if he encounters matter which is incomprehensible to him even though the practical conclusions are clear. Without claiming that scientific research is a complete cure for all the troubles of industry, Dr. Peirce urges that it is a method of securing the most effective use of available resources, and shows how, within the experience of the cotton industry, impersonal scientific methods have succeeded in saving efforts and resolving difficulties in the relations of firms or branches of the industry with

employees and between service departments Co-operation may ultimately lead the ideal of team work to merge in that of 'group work', groups having only their own ignorance or inefficiency as enemy, and in organisation by technical processes rather than by sciences

THE matter of publication is not without concern to the relations of science and industry, as pointed out by Dr Peirce, and a generous policy of publication for lines of pure scientific interest has a stimulating effect on the research staff from which the industry itself is the first to benefit. Publication assists in securing the recognition and interest from the universities, which are essential for open discussion, for combating the natural secretiveness of industry, and for creating a technical literature in which systematic cross reference becomes possible. These and other problems relating to the scientific reputation of the individual, the place of individual initiative and originality in co-operative research, are aspects of the relations between science and industry which are a modern phase of the conflict between authority and liberty. Much also remains to be done in redressing the present neglect of the borderland sciences, and cotton itself is of special interest in the borderland of physics. Finally, Dr Peirce suggests that by overcoming the technical difficulties of industry the scientific worker may remove obstacles to the development of beauty, and thus contribute to the artistic as well as to the humane aspect of industry.

#### Social Discontent and its Remedy

It is not altogether a new explanation of the social ills of the day to find a psychological rather than an economic explanation, but the theme is one that may well be stressed, and is ably expounded by Mr H. A. Bruce in a paper on "The Sources of American Discontent" (*Proc Amer Acad Arts and Sci*, vol. 67, No. 3, Feb. 1932). The social evils and discontent which Mr Bruce cites as being prevalent in America to-day are no less evident in many parts of Europe, and he finds the chief cause to lie in modern industrialisation, which not only narrows and starves the needs of the individual life, but also results in that crowding which leads to crowd mentality and all its drawbacks. The present state of affairs leads to discontent, adds to the prison population, the numbers of mental and nervous wrecks, and takes a mounting toll of suicides and lives shortened by bodily diseases promoted by mental stress. Mr Bruce admits the seriousness of the problem and the difficulties of solution when national policies are determined by majorities infused with the crowd spirit and on an arrested level of mental activity, but he makes the suggestion that the crowd spirit may itself be used to contribute to the acceptance of a wiser philosophy of life than is summed up in making money, spending money, and amusing oneself. Intensive education of a far-spreading kind is the agency to apply in changing the outlook of industrialised peoples, and leading them to an appreciation of values other than those which prevail to-day.

#### Hydrogen and its Uses

DR E. F. ARMSTRONG recently delivered a lecture on hydrogen and its uses before the Royal Society of Arts (*J Roy Soc Arts*, May 6). Two important methods of preparation of hydrogen are from water gas and coke oven gas. The carbon monoxide in water gas is oxidised to carbon dioxide by passing a mixture of the gas and steam over a catalyst containing iron oxide, the hydrogen of the reacting steam being set free. The small residue of carbon monoxide is removed by absorption under 200 atm pressure. The preparation from coke oven gas depends on purification by washing and fractional cooling, whereby first the methane and then the carbon monoxide is removed. The cost of production by either method under the most favourable conditions is about 1s per thousand cubic feet of hydrogen. The principal uses of hydrogen are for the hydrogenation of fats, in which liquid oils are converted into solid fats by taking up hydrogen in the presence of small quantities of nickel, the hydrogenation of other organic materials, including mineral oil, tar, and coal, and the production of synthetic ammonia. The conversion of coal into oil by treatment with hydrogen under pressure involves the use of an elaborate and costly plant, and so far as the production of petrol is concerned, the cost is put down at 7d-8d per gallon, as compared with a price of less than 2d per gallon at the oilfield. The prices may alter in future in favour of petrol from coal. If hydrogen is ever required in larger quantities by the oil industry, it could be obtained from the methane of natural gas or refinery waste gas, which readily reacts with steam to form hydrogen and carbon dioxide.

#### The National Physical Laboratory

THE Report of the National Physical Laboratory for the year 1931 is an illustrated quarto volume of 131 pages (London: H.M. Stationery Office, 15s. net). As usual, it gives a readable and interesting account of the progress of the work of each department without introducing technical details, and equally as usual, that progress must be gratifying to the Board and to the staff. The new physics building is now in use and the old quarters of physics are occupied by electrical standards. The compressed air tunnel building is completed, the new tank will be completed this year, and the new acoustics building has been commenced. Dr W. Rosenhan has left to take up other work, Prof C. H. Desch of Sheffield succeeds him, while Dr W. E. Dye has been lost by death. Ninety-seven official papers by members of the staff have been published during the year in the scientific or technical journals or in the proceedings of societies. We note the determination of the yard and metre in terms of the wave-length of the red cadmium line, the accurate measurement of time for radio frequencies, and an international agreement as to colour standardisation. Routine tests of almost all types have, with few exceptions, decreased. In the watch tests, the success of one Swiss firm is very remarkable.

### Land Conditions in Iraq

SOME valuable information regarding the irrigated and non-irrigated land in Iraq is contained in a report by Sir Ernest Dowson on "Land Tenure and Related Questions" (Baghdad Iraqi Government, 4s 6d). These statistics, which are shown also on large scale maps accompanying the report, were collected by the Irrigation Department, and show the immense possibilities for the extension of agriculture when conditions are favourable. It would appear that about twenty per cent of the total area of Iraq can be regarded as productive. This includes a northern rainfall zone covering about nine per cent, and a southern irrigation zone covering about eleven per cent. Not more than a fifth, and often as little as a tenth, of these zones are cultivated in any one year. An estimate of the rural population, for which complete accuracy is not claimed, puts the density of population so low as 19 per square kilometre in the rainfall zone, and about 35 in the most typical areas of the irrigation zones. These figures, especially the latter, are far below the potential population of the land, and compare unfavourably with the far greater density of population and higher productivity of similar lands in Egypt. Sir Ernest Dowson also comments on the lack of accurate topographical surveys in Iraq and the incompleteness of even the major triangulation. The report contains various recommendations regarding methods of land tenure, and naturally stresses, in this connexion, the need of further surveys.

### The Harpy at the London Zoo

OF the two well-known and remarkable neotropical birds of prey, the condor is a familiar menagerie exhibit, but the harpy always rare. The specimen the London Zoological Gardens has recently received being only the third exhibited during this century, although the species was shown early in their career. Although commonly called an eagle from its large size, the harpy is in form, coloration, and habits a giant goshawk, allied to the tropicopolitan group of hawk-eagles (*Spizaetus*). Like these, it presents the remarkable peculiarity of showing much more white in the immature plumage than in that of the adult, in fact, the present specimen, in its gull-like livery of white and grey, is curiously like a very different bird which is lodged next door to it in the Birds of Prey Aviary—the East Asiatic and Australasian white-bellied sea-eagle (*Circus leucogaster*). The ruff and crest of the harpy, however, give it a character quite unique among the Falconidae, and it is this species, rather than the golden eagle, which is the analogue of the lion among beasts, especially as its feet and talons are unrivalled for size and power in the whole series of birds of prey.

### A 'Deaf Speaker'

A NEW device which will aid the deaf to hear radio and gramophone music has been invented by Prof. F. Bedell, the well-known physicist of Cornell University. He calls it the 'deaf speaker' because it serves a function similar to a 'loud speaker' in a radio set. It does not broadcast sound, but carries vibrations of

the requisite amplitude and frequency to anyone who holds the receiving part of the apparatus with his teeth or pressed against his forehead or a cheekbone. From a summary of a radio talk reported by Science Service of Washington, D.C., on May 5, we learn that Prof. Bedell, working on the theory that most people who hear badly have a defective middle ear, sought to bring the sound waves to the inner ear by some other channel. He found that it could be done by bone conduction to the inner ear of the listener. It was not sufficient to transmit vibrations of the same frequency as the actual sound waves to the inner ear of the listener. They must first be adjusted to the requisite loudness and frequency. It is stated that this adjustment is substantially what takes place in the normal middle ear. Prof. Bedell's deaf speaker steps up the force of the sound waves very appreciably. Since some people are deaf to high tones and others cannot hear lower tones, the deaf speaker is provided with a device for altering the frequency. At a recent demonstration at the National Academy of Sciences, Prof. Bedell showed two kinds of receiving instruments, in one of which the receiver is held between the teeth and looks like a long tube, while the other consists of a flat disk held against the forehead or a cheekbone. The disk type has made it possible for deaf people with the aid of a microphone to hear their own voices. This apparatus is said to be very useful for teaching the deaf. It is portable, but is rather too large for everyday use.

### Earthquake in the Western Pacific

A STRONG earthquake occurred in the western Pacific on the morning of May 14. Its records were confused with those of another earthquake in the West Indian region, but the position of its epicentre has now been determined with the arrival of additional records from seismological stations surrounding and in the Pacific. It lies in about lat. 4° N, long. 130° E, as determined by the seismologists of the U.S. Coast and Geodetic Survey (Wire Report of Science Service, Washington, May 16). This point lies at sea, south-east of the island of Mindanao in the Philippines. The earthquake was clearly a severe one, as it is reported to have been felt distinctly to a distance of about 600 miles from the epicentre.

### Congress of Quaternary Geology

A MEETING of the Association for the Study of the European Quaternary will be held in Leningrad on Sept. 1-7. There will be two short excursions during the Congress and a long excursion from Sept. 8 until Sept. 29. Special arrangements have been made by the organising committee for the reception of members, and it is requested that geologists, archaeologists, and others who wish to attend should send in their names to the Secretary, Mr. K. Lebedev, V.O. Sredny Pr., 72-6, Leningrad 26. Particulars relating to the Congress, with programme of excursions, etc., can be consulted in the Library of the Museum of Practical Geology, 28 Jermyn Street, London, S.W.1, or at the Office of Intourist, Bush House, Aldwych, W.C.2.

## Announcements

PROF W A BONE, professor of chemical technology in the Imperial College of Science, will deliver the Bakerian Lecture before the Royal Society on June 9, taking as his subject "The Combustion of Hydrocarbons"

At the anniversary meeting of the Linnean Society of London held on May 24, the following officers were elected *President*, Prof F E Weiss. *Treasurer*, Mr F Druce, *Botanical Secretary*, Mr J Ramsbottom, *Zoological Secretary*, Lieut-Col J Stephenson. The Linnean Gold Medal was presented to Prof E S Goodrich

THE second conversazione of the Royal Society this year will be held in the rooms of the Society on Wednesday, June 22

At the annual general meeting of the Institute of Physics held on May 24, the following were elected to take office on Oct 1 next *President*, Lord Rutherford, *Honorary Treasurer*, Major C E S Phillips, *Honorary Secretary*, Prof A O Rankine. The other vacancies on the Board were filled by the election of Prof H S Allen and Dr C V Drysdale as vice-presidents, and Mr R A Watson Watt and Mr D Orson Wood as non-official members. Sir Frank Dyson and Sir William Bragg were elected honorary fellows of the Institute

From the interest derived from the invested capital of the Sir George Beilby Memorial Fund, at intervals to be determined by the administrators representing the Institute of Chemistry, the Society of Chemical Industry, and the Institute of Metals, awards are made to British investigators for distinguished original work in science, preference being given to investigations relating to the special interests of Sir George Beilby, including problems connected with fuel economy, chemical engineering, and metallurgy. Applications must reach the Convener, Sir George Beilby Memorial Fund, Institute of Chemistry, 30 Russell Square, London, W C 1, not later than June 14

THE eighty-fifth annual meeting of the Palaeontographical Society was held in the rooms of the Geological Society, Burlington House on May 27, Dr F L Kitchen, vice-president, in the chair. The report announced the completion of the monograph of fossil Macrurous Crustacea, by Mr Henry Woods, and recorded the publication of further instalments of the monographs of Corallian Lamellibranchia, Gault Ammonites, and Cambrian Trilobites. During the year, the Society received a small bequest from the estate of the late Dr Charles W Andrews. Mr L R Cox, Prof A Morley Davies, Prof W B R King, and Mr H Woods were elected new members of council, and Dr F A Bather, Mr Robert S Herries, and Sir A Smith Woodward were re-elected president, treasurer, and secretary respectively

THE Institute of Physics announces that the British Optical Instrument Manufacturers' Association (B O I M A) Prize for the best paper published in the *Journal of Scientific Instruments* during the year 1931

is to be equally divided between Mr H C H Townsend, of the National Physical Laboratory, for his paper on "A Daylight Factor Integrator", and Prof E W Marchant, Mr J K Burkitt, and Mr A H Langley, of the University of Liverpool, the joint authors of the paper, "A Portable String Galvanometer for use at Moderate Frequencies", and the Institute of Physics Prize for the best contribution to the laboratory and workshop notes in the *Journal* has been awarded to Mr F W Kirkby, of the Royal Aircraft Establishment, Farnborough, for his note, "Improved Method of holding Mirrors for Sextants and other Instruments"

THE next series of eight lectures and demonstrations at the London School of Hygiene and Tropical Medicine on tropical hygiene, for men and women outside the medical profession proceeding to the tropics, will be given by Lieut-Col G E F Stammers on June 14-23. Particulars can be obtained from the Secretary of the School, Keppel Street, Gower Street, W C 1

APPLICATIONS are invited for the following appointments, on or before the dates mentioned—A temporary assistant teacher of nautical subjects at the Nautical School and School for Fishermen, Boulevard, Hull—The Education Offices, Guildhall, Hull (June 11). A University reader in education at the Institute of Education (incorporating the London Day Training College)—The Academic Registrar, University of London, South Kensington, S W 7 (June 13). Evening teachers in fitting and machining and workshop processes and planning at the Wandsworth Technical Institute—The Secretary, Technical Institute, Wandsworth (June 13). A full-time lecturer in civil engineering in the Building Department of Rutherford Technical College—The Director of Education, Education Office, Northumberland Road, Newcastle-upon-Tyne (June 13). An assistant instrument maker in the Department of Physiology of University College, Cardiff—The Registrar, University College, Cathays Park, Cardiff (June 15). A professor of bacteriology in the University of Durham College of Medicine, Newcastle-upon-Tyne—The Registrar, University of Durham College of Medicine, Newcastle-upon-Tyne (June 18). A lecturer in the chemistry department of the Heriot-Watt College, Edinburgh—The Principal, Heriot-Watt College, Edinburgh (June 20). An assistant master at the Mining and Technical Institute and Boys' Junior Technical Day School, Neath, with the qualifications of an industrial chemist and possessing a degree in applied science, including metallurgy—The Director of Education, County Hall, Cardiff (June 21). A professor of medicine in University College, Galway—The Secretary, University College, Galway (June 30). Junior assistants under the directorate of explosives research, and a junior assistant under the directorate of ballistics research, of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S E 18. A full-time junior teacher for engineering subjects at the Oldham Municipal Technical College—The Director of Education, Education Offices, Oldham

### Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

#### Eland-Ox Hybrid

THE crossing of the eland and domestic cattle has been reported fairly frequently, and some years ago several cases were alleged in Southern Rhodesia. After a prolonged correspondence (1923), in which assistance was given by the local magistrate, the late Mr W Farrer, it was concluded that the reported hybrids were not authentic. The owner stated that they were almost indistinguishable from domestic cattle, and the fact that tame bull elands will readily serve domestic cows seemed a sufficient explanation of the alleged hybridism.

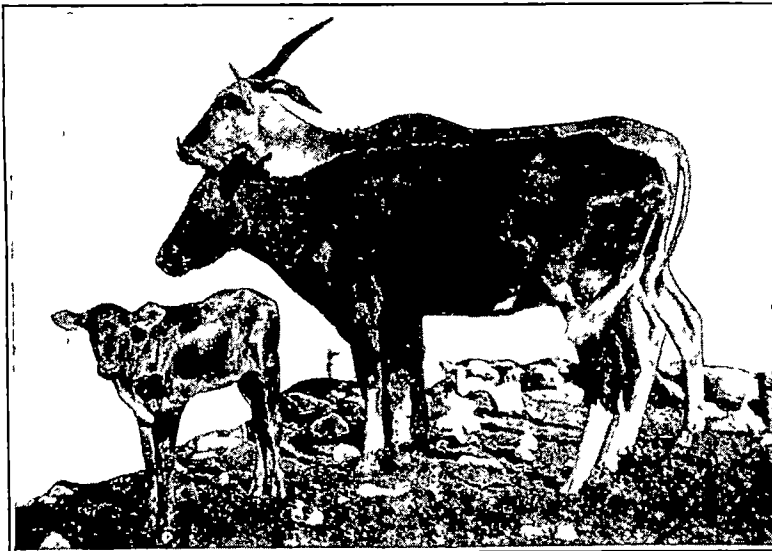


FIG 1—Bull eland, Afrikaner cow, and hybrid calf, Malpas Farm, Orange Free State

At the Government Experimental Farm at Cedara, Natal, attempts at crossing have had no result.

It would appear, however, that a successful cross has now been obtained (March 1932) at Malpas Farm, owned by Mr R E Helme, Westminster, Orange Free State, under conditions which would seem to preclude any possibility of doubt. On this farm there were half-a-dozen Afrikaner cows, but no bull of any description, except a bull eland which had been obtained from the Zoological Gardens, Pretoria, some three years ago, and this animal had been bred in the Gardens. Mr Helme, who is a Cambridge graduate and a scientific man, assures me that he has no doubt whatever as to the paternity of the male calf, and in a personal letter states, "It looks extraordinarily like an Afrikaner. The chief points of difference are the small pointed ears, slender limbs, heavy dewlap and a fawn colour mark on the side" (Fig 1).

The rhinarium would appear to be like that of the ox, but there is some development of the dorsal hump of the eland.

It is, of course, doubtful if the hybrid will prove fertile, but the cross is of considerable scientific interest, since the eland is really very different from the genus *Bos* in many important anatomical characters—and, so far as I am aware, a successful cross be-

tween two mammalian species of different genera has not previously been recorded.

From the general aspect of the young calf it would appear that the *Bos* characters will be markedly prepotent over the eland characters.

In this connexion it would be interesting to ascertain as to how far the chromosome complex of the eland differs from that of domestic cattle, but I do not know if any observations have been made even on the latter.

Natal Museum,  
Pietermaritzburg,  
April 12

ERNEST WARREN

#### Origin of Insects from Crustacea

THE problem of the origin of insects has for long remained unsolved. In recent years, interest in it has considerably increased and I have myself brought forward arguments<sup>1</sup> which, while still admitting the possibility of a descent from Crustacea, tend rather to the view that insects and Crustacea have no very close relationship.

The supporters of the theory of a crustacean origin for insects rely chiefly upon the attempt to prove that the insect leg was originally a biramous appendage of the type found in the Malacostraca, in other words, that it originally possessed a true exopodite as well as an endopodite (the main shaft of the leg). It has long been known without a shadow of doubt that the lobes of the insect maxillæ are merely endites or gnathobases developed from a uniramous stalk. The only structures which can reasonably be claimed to be exopodites are the *coxal styles* found on the middle and hind legs of the family Machilidæ. These styles closely resemble the *abdominal styles*, found in Machilidæ and other Thysanura, and believed to form part of the reduced abdominal appendages.

So far as I know, nobody has ever succeeded in hatching any Machilid from the egg or in otherwise dis-

covering the first instar of these insects. Heymons once stated (1897) that the abdominal styles of *Lepisma* did not appear until after the insect had hatched from the egg, but he was silent about the coxal styles of *Machilis*.

The position has become something of a 'stalemate', and further argument has appeared to me useless until such time as the first instar of a Machilid could actually be discovered. I have, therefore, fixed my attention on this point for the past two years. Thanks to the co-operation of Mr Royce Cannon, a student of the University of Queensland, success has at last been attained. Machilidæ are very rare insects in Australia, but Mr Cannon succeeded in discovering a locality near Brisbane where, amongst deep rubble and decaying leaves below a sheltered wall of rock, a species of *Allomachilis* could always be found. He has recently sent me specimens of the first, second, and many subsequent instars. I am now able to state definitely that this insect hatches from the egg with its abdominal styles fully formed, but *without any sign of coxal styles*. The second instar, like the first, is devoid of coxal styles, and it is only in the later instars that these organs are formed. At no time do they possess muscles, whereas the abdominal styles are provided with muscles from the very start.



We are, therefore, justified in concluding (1) that the abdominal styles are *not* serially homologous with the coxal styles in Machilidae, (2) that the abdominal styles are parts of the original embryonic appendages, and (3) that the coxal styles are certainly *not* parts of such original appendages, but are merely

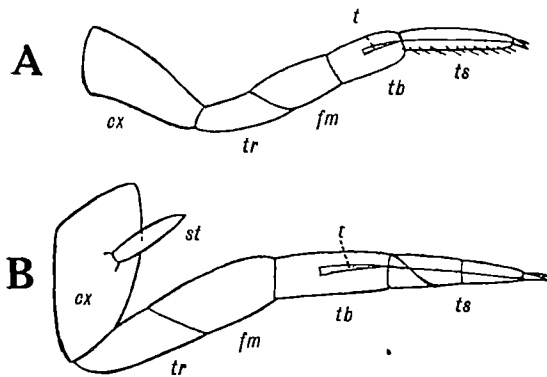


FIG 1—*Allomachilis* sp., Brisbane, Queensland. A Middle leg, first instar. B Middle leg, from specimen two-thirds grown. cx, coxa, fm, femur, st, coxal style, t, tendon of claw, tb, tibia, tr, trochanter, ts, tarsus (unjointed in A, three-segmented in B). A,  $\times 40$ , B,  $\times 75$ .

secondarily developed *spurs* without any muscle supply and having a deceptive resemblance in form to the abdominal styles.

For the benefit of those interested in the general problem, I append herewith a table showing the correct interpretation of the various limb processes in insects which, at one time or another, have been claimed by supporters of the theory of crustacean origin of insects to be true exopodites.

| Appendages                              | Process claimed to be Exopodite                 | Correct Interpretation                                                                                                                                                                   |
|-----------------------------------------|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| First maxillæ                           | Lacinia                                         | Endite (Gnathobase)                                                                                                                                                                      |
|                                         | Galea                                           | Endite (Gnathobase)                                                                                                                                                                      |
| Second maxillæ                          | Glossa                                          | Endite (Gnathobase)                                                                                                                                                                      |
|                                         | Paraglossa                                      | Endite (Gnathobase)                                                                                                                                                                      |
| Middle legs                             | Coxal style (Machilidae only)                   | Coxal spur without musculature                                                                                                                                                           |
| Hind legs                               | Coxal style (Machilidae only)                   | Coxal spur without musculature                                                                                                                                                           |
| Gonapophyses of ninth abdominal segment | Inner valve (female) (Claimed by Crampton only) | Either (a) telopodite (endopodite), the dorsal valve then being the limb-base carrying a style, or (b) secondary process of the limb-base, the style representing the reduced telopodite |
| Cerci                                   | Paraproct (Claimed by Crampton only)            | Secondary outgrowth of the eleventh sternite, <i>not</i> part of an appendage, the cerci being the complete appendages of the eleventh segment                                           |

I think the accompanying table shows conclusively that there is now not a shred of evidence left, from a consideration of the appendages, that insects were ever derived from ancestors possessing biramous limbs of the Malacostracan type. That being so, it

seems to me that the theory of the crustacean origin of insects is now effectively disposed of, and attention should be directed to more promising lines of inquiry.

R. J. TILLYARD

Canberra, F. C. T., Australia,  
Feb 28

<sup>1</sup> NATURE, 126, 996, Dec 27, 1930

### Nuclear Spin of Phosphorus from the Band Spectrum

THE extensive band system of  $P_2$  in the ultra-violet is easily produced with considerable intensity by an uncondensed discharge through pure phosphorus vapour contained in a quartz tube. Regularities in the frequencies of the band heads were first found by Geuter, but the correct quantum designation of the bands has only recently been established by the work of Jakowlewa<sup>1</sup> on the absorption and fluorescence of the more refrangible part of this system. Two years ago, Herzberg reported, in a letter to NATURE, that a sudden breaking off occurs in the band progressions associated with various upper vibrational levels (at  $v' = 11$  with the present assignment of vibrational quantum numbers), which can only be attributed to predissociation<sup>2</sup>. Herzberg also found that the rotational lines of the bands of highest observed  $v'$  stop suddenly, as was to be expected in consequence of the predissociation.

Since an alternation of intensity in the band lines should be observed in the spectra of molecules composed of two like atoms, provided the nuclear spin is finite and not too large, we have obtained high-dispersion spectrograms of the  $P_2$  bands in an attempt to detect this. Although no alternation has been mentioned by previous investigators, our plates showed clearly that the intensities alternate in a ratio which we estimated at 3:1 in our first report on this work<sup>3</sup>. Since then, we have obtained better plates in the second order of a 21-foot grating, and carried through the analysis of the rotational structure by means of the combination principle. The newer results leave no doubt that the alternation of intensities is real, and that the nuclear spin of the phosphorus atom must be  $\frac{1}{2}$ , as required by the

alternation ratio of 3:1. Quantitative intensity measurements, which are now in progress, will almost certainly confirm this. Furthermore, we find that the odd numbered rotational levels ( $K'' = 1, 3, 5, \dots$ ) of the lower state have greater statistical weight, and since this state is  $^1\Sigma_g^+$ , like the normal state of nitrogen, the complete wave-function of the molecule must be antisymmetrical,  $A_n$ , and the nuclei obey the Fermi-Dirac statistics.

A great many of the bands in the longer wavelength part of the spectrum, which can be studied with the grating, show marked perturbations of the rotational structure. Some of those which are sufficiently regular to yield reliable values of the band constants have been measured, including the following: 6,22 ( $\lambda$  head 2970.75), 6,23 (3028.00), 8,27 (3166.14), 8,28 (3228.65), and 9,28 (3183.84). From these we find, as preliminary values  $B_v'' = B_v' - a(v' + \frac{1}{2}) = 0.3045 - 0.00152(v' + \frac{1}{2})$ ,  $B_v' = 0.2410 - 0.00165(v' + \frac{1}{2})$ . The value of  $B_v''$  gives the moment of inertia of  $P_2$  in its normal state as  $90.8 \times 10^{-40}$  gm cm<sup>2</sup>, and the internuclear distance,  $r_v'' = 1.88 \times 10^{-8}$  cm. The latter figure is unexpectedly large, if we compare it with the  $r_v''$  of  $S_2$  ( $1.603 \times 10^{-8}$  cm) and with that predicted by Morse's empirical rule ( $1.5 \times 10^{-8}$  cm). There is no ambiguity, however, in the determination of our values of  $B_v$ . The bands are of the simple  $^1\Sigma, ^1\Sigma$  type, consisting of singlet

*P* and *R* branches, and only one assignment of rotational quantum numbers fulfils the combination principle exactly. Our conclusion as to the type of electronic transition involved agrees with that reached by Herzberg<sup>4</sup> as the result of unpublished work. A cursory examination of the breaking off of the rotational structure for bands with  $v''=10$  and 11 also confirms his statements in this connexion. We do not propose to investigate the detailed effects of predissociation in this spectrum, as we understand that Dr Herzberg is continuing his work in this phase of the problem.

F A JENKINS  
MURIEL ASHLEY

Department of Physics,  
University of California,  
March 17

<sup>1</sup> *Z. Physik*, 69, 548, 1931

<sup>2</sup> *NATURE*, 126, 239, Aug 16, 1930

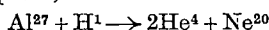
<sup>3</sup> *Phys. Rev.*, 39, 552, 1932

<sup>4</sup> *Erg. exakt. Naturw.*, 10, 273, 1931

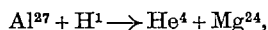
### Disintegration of Atomic Nuclei

THE epoch-making results as to the disintegration of atomic nuclei recently obtained in the Cavendish Laboratory serve to recall the experiments of Prof J N Collie and his fellow-workers made twenty years ago. In some of these experiments it was thought that helium and neon were produced by sending powerful electric discharges through exhausted tubes. Sir William Ramsay observed the presence of helium in an old X-ray tube. Little information is available in the published accounts as to the potential difference employed in the experiments or as to the previous history of the (aluminium) electrodes. It was generally supposed that the balance of evidence was against such transformations, but it is possible that the failure of other investigators to reproduce the results of Collie may have been due to the fact that the precautions which they took resulted in an insufficient supply of swift protons in the discharge tube.

Be that as it may, taking into consideration the old and the new experiments, I should like to suggest that the aluminium nucleus, for example, may yield neon on disruption, in accordance with the process



In his report<sup>1</sup> of the discussion on the structure of atomic nuclei at the Royal Society, Dr Ellis emphasises the uncertainty in speculating about such processes as



but, in view of the possibility of the nucleus being built up of shells in a fashion somewhat resembling the electronic structure of the chemical atom, the suggestion that the neon nucleus is present in aluminium seems worthy of consideration.

In the second place, I should like to enter a caution as to accepting the particles of mass unity discovered by Dr Chadwick in beryllium 'radiation' as representing the ultimate neutron. In a paper<sup>2</sup> on quantum magnetic tubes in rotation, published in 1925 and described in my book on "The Quantum and its Interpretation", I developed a suggestion due to Prof E T Whittaker, that the difference between positive and negative electric charges might be interpreted as arising from different directions of rotation of the tubes. In the admittedly crude model there described, the mass of the neutron, in which there is no rotation of the tubes, would be the arithmetic mean of the masses of the proton and the electron. It therefore seems possible that the corpuscle of mass unity is composed of two neutrons. For, according

to the hypothesis mentioned, the neutron is a magneton, and magneton pairs are likely to occur. Electron pairing is now recognised as an important factor in molecular structure, and may be attributed to the magnetic properties of the electron.

Experiments in an inhomogeneous magnetic field may serve to show that the corpuscles of Dr Chadwick possess a magnetic moment, but probably the magneton pair would constitute a neutral magnetic system of small magnetic moment. Further search might be made for particles of about half the observed mass and possessing a magnetic moment.

H S ALLEN

The University, St Andrews,  
May 11

<sup>1</sup> *NATURE*, 129, 674, May 7, 1932

<sup>2</sup> *Phil. Mag.*, 49, 981, 1925

### Oscillations of the Methane Molecule

FROM a consideration of the infra-red absorption data, Dennison<sup>1</sup> assigned 1304, 1520, 3019, and 4217 as the fundamental frequencies of the methane molecule, the highest, 4217, representing a symmetric expansion of the tetrahedron. In the Raman spectrum of methane, however, 4217 fails to appear, and we have instead a frequency 2918 recorded as an intense and sharp line, which is inactive in infra-red absorption and is therefore to be identified with a symmetric oscillation of the tetrahedron. I have accordingly suggested in a recent paper<sup>2</sup> that the fundamental frequencies of methane are 1304, 1520, 2918, and 3019, the frequency 4217 being merely a combination of the first and the third fundamentals.

Striking evidence in support of the new assignment is now forthcoming from observations made by me on the state of polarisation of the Raman lines. It is found that 2918 is nearly completely polarised ( $\rho=0.08$ ), whereas the line 3019 is nearly unpolarised ( $\rho=0.8$ ), thus presenting a complete analogy with the state of polarisation already ascertained for the third and fourth fundamentals in the case of the tetra-chlorides. It is interesting to note that in the Raman spectra, 3019 appears accompanied by vibration-rotation components, while the more intense 2918 fails to exhibit them.

S BHAGAVANTAM

210 Bowbazar Street,  
Calcutta, India,  
April 1

<sup>1</sup> *Astrophys. J.*, 62, 84, 1925

<sup>2</sup> *Ind. J. Phys.*, 6, 595, 1931

### Swarming of Collembola in England

THE swarming of certain species of Collembola has been previously noted in Europe by several authors, notably Nicolet,<sup>1</sup> Low,<sup>2</sup> Linnaniemi,<sup>3</sup> Latzel,<sup>4</sup> and Handschin,<sup>5</sup> and more recently J M Brown,<sup>6</sup> in a paper in the *Naturalist* for 1921, recorded several instances of this occurring in the north of England. The species in which he observed this phenomenon were *Podura aquatica* L., *Hypogastura viatica* (Tullb.), *Hypogastura purpurea* (Lubb.), *Anurida maritima* Lab., *Isotomurus palustris* (Mull.), *Sminthurides malmgreni* var. *elegantula* Reut., *Sminthurinus aureus* var. *ochropus* Reut. All except the *Sminthurinus* and *Hypogastura purpurea*, which were found on an old stone wall, are recorded as occurring on water.

In January this year I found two instances of the swarming of *Onychurus armatus* (Tullb.). On Dec 4, 1931, considerable numbers, mostly of the adult form of the species, were noted in a heap of dead leaves in a garden in Balham. By Jan 18, 1932, the numbers

had greatly increased, so that parts of the heap were covered over with a creamy-white layer of the insects. The swarm was at the time composed of a very high percentage of immature forms. From about two cubic inches of mould I obtained some 130 individuals. The species is one which, as Brown observes, is known to be gregarious in its habits, but this is, I believe, the only recorded instance of its swarming.

Two other instances of this phenomenon were witnessed in the London area in the late autumn of 1931. The first of these was the occurrence of large numbers of *Hypogastura viatica* (Tullb.) on a small pool of stagnant water on Wimbledon Common in October. They appeared in such numbers as to form a black band to a width of one foot or more around the margin of the pool. This swarm was composed almost equally of adult and immature forms. The second of these two likewise occurred on Wimbledon Common. In September 1931 great numbers of *Sminthurus viridis* (Linn.) were seen on an old wooden post which, although only 4 ft high, had on its surface several hundred individuals, one side being almost completely covered.

In most of these cases of swarming (if not all) the factor producing this phenomenon would seem to be the relative abundance of the food supply. It may be supposed that an exceptionally suitable food supply of small extent and, in the case of winter breeding species like *Onchururus armatus*, a spell of mild weather, increases the reproductive activities of the species, resulting in large numbers of immature forms which on a habitat of limited extent cause the appearance of the swarm. Other explanations of this swarming of *Collembola* would seem to be those of migration, as suggested by McNamara,<sup>7</sup> or possibly the sudden cessation of controlling influences. This last may perhaps go some way towards accounting for the swarming of *Sminthurus viridis* recorded above, as Lubbock<sup>8</sup> states that it is attacked by a small red mite which if fairly numerous in any locality might become a controlling factor of a very potent kind.

It is a significant fact, and one having some bearing on explanations, that all the species in which swarming has been recorded are gregarious.

F. A. TURK

18 Fernside Road,  
Balham, S W 12

<sup>1</sup> Nicolet, H., "Recherches pour servir à des Podurelles"—N. Denkschr. Schweiz. Ges. Naturw., 6, 1-88, 9 pls., 1841.

<sup>2</sup> Low, J., *Verh. Zool. Bot. Ges. Wien*, 8, p. 564, 1858.

<sup>3</sup> Linnamemi, W. M., "Die Apherygotenfauna Finlands", I. Allgemeine Teil, *Acta Soc. Sci. Fenn.*, 34, No. 7, 1907.

<sup>4</sup> Latzel, "Papers on *Collembola* occurring in Snow. Carinthia. Klagenfurt", 97.

<sup>5</sup> Handschin, E., "Über die *Collembolen*fauna der Nivalstufe", *Rev. suisse Zool.*, 1919, and others.

<sup>6</sup> Brown, J. M., "The Swarming of *Collembola*", *Naturalist*, 1921.

<sup>7</sup> McNamara, *Canadian Naturalist*, Nov. and Dec. 1919.

<sup>8</sup> Lubbock, Ray Soc. Monograph on *Collembola*, 1873.

### Internationalism and Science

WHEN in South Africa last year, I tried to understand the politics of that country, turning largely on the differences between the British and the Dutch South Africans. Discussing the relative merits of two great South African leaders, I was told that one stood for the Empire, the other for South Africa, or that one was a practical politician, the other was not. But the substance of the matter seemed to be this, that one was predominantly intellectual, the other predominantly emotional. Now, when crossing the ocean, I much prefer a captain who guides the ship by means of his intellect, to one who does it by his emotions. We can scarcely think otherwise of the ship of State. Yet the emotions are very precious to us all, and to a very great extent we live by and for them.

Science, belonging to the intellectual sphere, must from its very nature be international. The scientific fraternity is the true International. But the emotional part of our nature is necessarily personal, or local, or national, rather than international. The arts serving our emotional needs should be similarly personal or local, and when they lose that quality they often deteriorate.\* A very good example is the world fashion in clothing, causing 'well-dressed' young women to appear alike, whether in Central Asia or South America. On this basis we can understand why the Dutch South Africans cling to their peculiar language, a thing at first appearing so perverse and so useless. They do not wish their 'culture', the emotional side of their nature, to be submerged by the tide of Anglo-American 'civilisation'. I will not say that this justifies the use of Afrikaans in South Africa or Irish as the standard language of Ireland, but at any rate the motive has a genuine basis in the desire to preserve something of value.

In the field of religion we have a similar conflict. The Churches serve as an outlet for the emotional nature of man on a high plane, and are in that sense a necessity for his well-being. But on the intellectual side they offer us a conflict of doctrines having a traditional basis, which for the most part wither away when exposed to the light of modern science.

The general outcome is this, that science is and must be the leading international cult, and must be our guide in the practical affairs of life. But scientific men must recognise the limits of internationalism on the emotional side, and the positive disadvantage of trying to make all people *feel* alike. Thus the British should adopt and absorb everything of value in American science, but would be quite justified in excluding the American cinema, which tends to create an emotional attitude which is not British, or at any rate not in accordance with the ideals on which the future of Britain should be established. I recently heard a very able speaker, just returned from Europe, discuss what the students of Europe *think*. His discussion was very illuminating, but he was principally describing what they *feel*. That they should feel keenly and ardently is well enough, but it is dangerous to the public peace when they have only *felt*, but imagine themselves to have *thought*. To separate these two great functions of the mind, and give each its proper place, appears to be fundamental for human progress on sound lines.

T. D. A. COCKERELL

University of Colorado,  
Boulder, Colorado,  
April 11.

\* Rare masterpieces may be so elemental or fundamental in their appeal that they have little relation to time or place.

### Stokes's Formula in Geodesy

I QUITE agree with the opinion expressed by Mr. Gulattee of the Survey of India<sup>1</sup> that Stokes's formula for the elevation of the geoid above the spheroid of reference is rather sensitive to systematic errors in gravity. The proper course seems to be, however, not to abandon Stokes's formula but to try to rid of error the reduced values of gravity, so that the results of applying the formula may be trusted.

The reason for this statement is that Stokes's formula furnishes the only known method—accurate or not—for obtaining the absolute elevations of the geoid referred to the spheroid without making some hypothesis as to the distribution of densities within the earth. The deflexions of the vertical can, in the nature of the case, give relative elevations only. Further—

more, until we can perform at sea operations equivalent to our triangulation and astronomical measurements on land, Stokes's formula furnishes the only means of obtaining the distance between the geoid and the spheroid over the oceans, that is, over nearly three-quarters of the area of the globe, unless again we resort to hypothesis. For example, the geoid may be computed for any region, whether on land or sea, by assuming a definite theory of isostasy. Interesting specimens of the contours of the geoid computed on the theory of isostasy may be found in the "Geodetic Reports of the Survey of India", vol 5, and in the *Geophysical Supplement to the Monthly Notices of the Royal Astronomical Society* (vol 3, No 1, Jan 1932).

Even with the admitted sensitiveness to the effect of error in reduced values of gravity, and with the consequent uncertainty in the geoid heights, the formula may be accurate enough to give valuable information about certain geophysical questions to which even a rough answer may be of value. For example, is the geoid over the deeper parts of the oceans depressed below the spheroid of reference, as the theory of isostasy would require, or is it raised above the spheroid, as certain observations of gravity at sea, admittedly too few to be conclusive, would seem to suggest? Is the form of the geoid more nearly a triaxial ellipsoid than an ellipsoid of revolution? Or more accurately stated, does the ellipsoid most nearly representing the earth as a whole deviate from an ellipsoid of revolution sufficiently for the deviation to have substantial geophysical significance?

Of course, as Mr. Gulattee suggests, Stokes's formula may be useful for determining relative or differential elevations of the geoid above the spheroid. It seems to me, however, that in regions where triangulation and astronomical observations are available the deflexions, as determined from these, ought to give a better idea of the differential elevations from Stokes's formula. The main value of the latter is for absolute elevations.

WALTER D. LAMBERT

U S Coast and Geodetic Survey,  
Washington, D C,  
March 21

<sup>1</sup> NATURE, 129, 279, Feb 20, 1932

#### Errors in Thermal Measurements

PROF. PARTINGTON directs attention<sup>1</sup> to errors which are likely to be present when resistance thermometers are used in measurements of heats of adsorption. He does not refer to thermocouple thermometers directly, but he includes in his references papers which describe their use. Although calorimeters in which such thermometers are used are far from perfect, the situation is not quite so black as his letter might lead one to believe. For example, results have been obtained with these thermocouple calorimeters which agree with those of the ice calorimeter.<sup>2</sup>

The nature of the errors met with in measurements of heats of adsorption depends to some extent on the type of adsorption studied. Where adsorption is very rapid, care must be taken that the following conditions hold. It is essential that (a) the calorimeter be completely surrounded with objects at a constant temperature, (b) that the gas be admitted to the centre of the adsorbent and not to the sides of the mass, and (c) that sufficient length of the thermocouple leads be immersed in the adsorbent. (a) and (c) can be tested by the admission of an inert gas which will change the temperature in the neighbourhood of the junction

unless the enclosure is at constant temperature, or if appreciable quantities of heat are conducted away by the thermocouple leads outside the calorimeter. When such precautions are taken, no maxima are obtained on the differential heats of adsorption curves similar to those recorded in results of earlier work.<sup>3</sup> When a high vacuum is obtained after adsorption, as is the case for the adsorption of oxygen on charcoal, the rate at which heat is distributed throughout the calorimeter is slow. In this case, it takes two to five minutes before the rate of cooling obeys Newton's Law. This causes an uncertainty in the value deduced for the heat of adsorption of not more than 5 per cent, and in some cases the error may be much less than this.

Where adsorption is not very rapid, (b) is an unnecessary precaution.<sup>4</sup> Since adsorption is slow, it is, however, necessary to make continuous measurements of pressure and temperature simultaneously in order that suitable corrections can be made to the cooling curves. In such cases, however, since adsorption usually occurs at high pressures, the thermometric lag is generally small.

The development of thermocouple calorimeters for measurements of heats of adsorption is of importance since these afford the best means of measuring these values at temperatures other than room temperature.

W. E. GARNER

Department of Physical Chemistry,  
University, Bristol,  
May 2.

<sup>1</sup> NATURE, 129, 615, April 23, 1932.

<sup>2</sup> Bull. Hall, and Garner, *J. C. S.*, 839, 1931. Marshall and Bramston-Cooke, *J. A. C. S.*, 51, 2019, 1929.

<sup>3</sup> Bull. and Garner, NATURE, 124, 409, Sept. 14, 1929.

<sup>4</sup> Garner and Kingman, *Trans. Far. Soc.*, 27, 322, 1931.

#### Free Ethyl

THE demonstration by Paneth and his collaborators of the existence first of the methyl<sup>1</sup> and quite recently of the ethyl<sup>2</sup> radicals in the free state has not, so far as we are aware, received independent confirmation. As apparatus capable of giving high streaming rates at suitable pressures being available in connexion with other researches which are engaging our attention in these laboratories, it appeared of interest to repeat the thermal dissociation of lead tetraethyl.

The material supplied by British Drug Houses was fractionated in a vacuum before use, and the operations were carried out in hydrogen, especial precautions being taken to ensure the absence of oxygen and moisture in the gas or on the surface of the apparatus. The velocity of the gas stream was 7.5 metres per second at pressures varying from 1.3 mm through the transparent silica tube of 6 mm internal diameter in which the phenomena were observed. So far as they went, our results confirm entirely the experiments of Paneth and Lautsch,<sup>2</sup> namely (1) the removal of lead mirrors was readily detectable 10 cm away from the source of the aggressive agent, (2) there was reformation of material which in turn yielded a mirror on heating, (3) an approximate measurement of the life period gave a result of the same order as that found in the original experiments.

T. G. PEARSON  
P. L. ROBINSON.  
E. M. STODDART

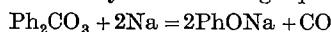
University of Durham,  
Armstrong College,  
Newcastle-upon-Tyne,  
April 7

<sup>1</sup> Paneth and Hofeditz, *Ber.*, 62, 1335, 1929.

<sup>2</sup> Paneth and Lautsch, *Ber.*, 64, 2702, 1931. *idem ibid.*, 2708.

### Carbon Monoxide from Carbonates

IN the course of an investigation of the stability of certain ketylic derivatives we have found that carbon monoxide is produced in quantitative yield through the interaction of metallic sodium with certain non-polar carbonates. Thus, sodium reacts readily with a warm xylene solution of diphenyl carbonate with the formation of sodium phenoxide and carbon monoxide, as indicated by the following equation



The evolution of carbon monoxide proceeds quite smoothly and the gas is obtained in a state of high purity. In fact, the reaction is well adapted for the laboratory preparation of pure carbon monoxide. It is also interesting to note that the gas as thus prepared is so dry that it does not explode on 'sparking' with dried oxygen.

The above reaction also occurs with alkyl carbonates, such as ethyl carbonate.

We have obtained evidence to show that the reaction occurs through the intermediate formation of ketylic derivatives. The dimeric forms of these derivatives, containing the phenoxy group, are unstable and suffer rapid decomposition with the elimination of sodium phenoxide. On these premises, it is interesting to note that the immediate precursor of carbon monoxide is the unknown oxide,  $\text{C}_3\text{O}$ .

Work along these lines is in progress in this laboratory, and further details will be published elsewhere.

S T BOWDEN  
T JOHN

The Tatem Laboratory,  
University College, Cardiff, April 15

### Electrostatic Explanation of the Phenomenon of Flotation

PROF KAMIENSKI suggests<sup>1</sup> that the adsorption of certain organic substances at the surfaces of platinum, graphite, and galena is due to an electrostatic attraction between them and globules of an emulsion formed by the organic substance. It is claimed that these solid surfaces are positively charged and that the emulsion is negatively charged. He then proposes that such an action is the basis of flotation.

This explanation of the basis of flotation is unsatisfactory. Adsorption of xanthates occurs readily from true solutions of their alkali salts, and flotation is possible in the absence of any emulsification. Moreover, the author himself states that there is a decrease in the potential of the surface, even when the emulsion is so dilute that its character is lost. It is uncertain what is meant by this change, but if it means a transition to true solution, the experimental results become very interesting in another connexion. They would then hint that adsorption from solution is accompanied by a decrease in the potential of the surface, from which it might be argued that negative ions—presumably xanthate ions—are adsorbed. This conclusion has been reached on other grounds.

IAN W WARK

Department of Chemistry,  
University of Melbourne, Feb 19.

<sup>1</sup> NATURE, 129, 59, Jan 9, 1932

### The Cry of Tin

THE experience of Dr Chalmers<sup>1</sup> with regard to the 'cry' emitted by cadmium and tin during plastic deformation agrees exactly with that of Mathewson and Phillips<sup>2</sup> obtained in coarsely crystalline zinc. In 1927 they recognised and discussed a silent process of simple slip which was unproductive of twins, and,

furthermore, a type of deformation which caused both a 'crackle' and multiple twinning.

In his letter, Dr Chalmers states that he has not been able to produce a cry with any metal crystallising in a cubic system, for which twinning does not take place. Lest there be any ambiguity, it may be said that cubic metals sometimes show mechanical twinning, the Neumann bands of  $\alpha$ -iron being a case in point. During experiments involving the cold-rolling of crystals of iron containing 1.8 per cent of silicon, I distinctly heard a crackling sound from the metal, and subsequent examination showed the presence of twins.<sup>3</sup> That this is no unique observation is evident from the work of Mathewson and Edmunds<sup>4</sup> on silicon-bearing iron, but they take the matter somewhat further. In their 1928 paper we read "Single crystal strips with cubic planes nearly parallel to the surface, cracked noticeably when pinched between rolls but produced only a few bands. When rolled on dodecahedral planes, virtually all the deformation occurred by a quiet slipping process." It may be pointed out here that compression or rolling of iron crystals on (011) faces produces much more strain-hardening than compression on cubic faces.

Dr Chalmers observes that the 'cry' was only noticed in aggregates which exceeded a certain crystal grain size. I have observed that in  $\alpha$ -iron the larger the grain size the greater is the ease of production of Neumann bands, and the smaller the resistance of the metal to failure by shock.<sup>5</sup> Ordinary fine-grained iron only twins at room temperatures by impacting, but the addition of certain other elements both enlarges the grain size and permits of the production of twins by static deformation. The elements which behave in this way are phosphorus, tin, silicon, and aluminium, and it is perhaps not without significance that metallurgically they may roughly be described as deoxidisers.

HUGH O'NEILL

The Victoria University of Manchester,  
May 9

<sup>1</sup> NATURE, 129, 650, April 30, 1932

<sup>2</sup> Amer Inst Min Met Eng, 143, 1927

<sup>3</sup> Amer Inst Min Met Eng (Iron and Steel), 229, 1928

<sup>4</sup> Amer Inst Min Met Eng (Iron and Steel), 311, 1928

<sup>5</sup> J Iron and Steel Inst, 1, 417, 1926

### Isotopic Constitution of Lead

As described in a previous communication,<sup>1</sup> we have found from the hyperfine structure of the lead spectrum that the ordinary element contains, in addition to  $\text{Pb}^{208}$ ,  $\text{Pb}^{206}$ , and  $\text{Pb}^{207}$ , a fourth isotope,  $\text{Pb}^{204}$ , with an intensity of 1 per cent. Owing to the presence of mercury (particularly  $\text{Hg}^{204}$ ) in the discharge, the first analysis of lead by means of the mass spectrograph could not detect this new isotope. Recently, Aston<sup>2</sup> has repeated his analysis and reported  $\text{Pb}^{204}$ , together with four other weaker isotopes (209, 203, 205, and 210).

As our communication was not mentioned by Aston, we wish to point out that his data concerning  $\text{Pb}^{204}$  are in good agreement with ours. Although, according to Aston's results, 209 is just sufficiently intense to be observable by our method, our plates show no indications of its presence. With regard to 203 and 205, which are also the mass-numbers of the thallium isotopes,<sup>3</sup> it should be mentioned that thallium was always present in spectroscopically appreciable quantities in all our samples of ordinary ('accumulator') lead. We therefore consider that the possibility of a contamination of the sample by traces of thallium should not be overlooked before the mass numbers 203 and 205 are finally attributed to lead. This point illustrates an advantage of the spectroscopic method, as the wave-lengths of the spectral lines are determined

chiefly by the external electron configuration of the atom—the isotopic effect enters only as a part of a hyperfine structure of the individual multiplet lines

On account of the increased attention now being given to the study of very rare isotopes (abundances less than 1 in 1000) we would like to suggest that, in investigations where the isotopes of neighbouring elements (present as impurities) might cause difficulty, the preparations should be submitted to a spectroscopic analysis before the results are considered as final. As is well known, the sensitivity of the spectroscopic method surpasses that of any chemical test

H SCHULER  
E GWYNNE JONES

Astrophysikalisches Observatorium,  
Einstein-Institut, Potsdam,  
May 4

<sup>1</sup> H Schuler and E G Jones, *Naturwiss.*, **20**, 171, 1932

<sup>2</sup> F W Aston, *NATURE*, **129**, 649, April 30, 1932

<sup>3</sup> H Schuler and J E Keyston, *Z. Phys.*, **70**, 1, 1931, confirmed by F W Aston, *NATURE*, **128**, 725, Oct. 24, 1931

### Activated Adsorption of Hydrogen

THE great revival of interest in adsorption measurements, carried out in connexion with catalytic experiments, which is manifested by the Oxford meeting of the Faraday Society, and by other similar publications, has prompted us to announce some results which we have obtained

The adsorptions of hydrogen, hexane, cyclo-hexane, and benzene, at temperatures up to 450°, have been measured on a large number of metallic oxides. Attention has been primarily concentrated on substances which have known catalytic activities in hydrogenation, and on those which have not already been inspected by Prof Taylor in Princeton. We have discovered that extensive 'activated' adsorption of hydrogen occurs with oxides of molybdenum, vanadium, chromium, and tungsten, and with metallic tin and cadmium

Adsorption of hydrocarbons at high temperatures (up to 450°) is now found to be a still more general phenomenon, and takes place with every metal or metallic oxide which we have inspected so far (Cr, Ti, Fe, Cu, Mo, Zn, Cd, Ca, Zr, Mg, Sn, Co, Al, Mn, and W). The velocity and extent of the adsorption vary greatly in different cases, and are also considerably influenced by the presence of impurities, complications due to interaction of hydrogen with the solid have been avoided by pretreatment of the latter

It is hoped to give an account, *in extenso*, of these experiments in the near future, as they should provide an interesting contribution to the study of catalysis

H HOLLINGS  
R H GRIFFITH

Fulham Laboratory,  
The Gas Light and Coke Co.,  
London, May 12

### Interaction of Flavones and Anthocyanins

ROBINSON and Robinson<sup>1</sup> have recently directed attention to the existence of 'co-pigments' which, entering into loose combination with anthocyanin pigments, modify their colour

In the course of my genetic experiments on *Dahlia variabilis*, it was found that the ivory flavone in the flowers apparently had the property of changing the anthocyanin colour in the direction of blue, for example, cyanin alone gives almost a chocolate colour but with ivory flavone the colour is bluish-purple. Apparently ivory flavone acts as a co-pigment for cyanin and pelargonin in *Dahlia*

Recently I have tested, *inter alia*, the crude pigment extracts from flowers of widely different plants (for example, *Dahlia*, *Primula* spp., *Pelargonium*, *Tulipa*, and *Pulmonaria*). In a number of cases the ivory flavone pigments, independent of hydrogen ion concentration, have been found to bring about modification of anthocyanin colour. The blueness disappears on heating the solution, but returns on cooling. The ivory flavone effect may be additional to that of co-pigments, other than flavone, already present. Reciprocal differences were found in certain cases

Further, in *Dahlia* there is an inverse correlation between the production of flavones and anthocyanins, the interaction being reciprocal, but to the advantage of the flavones, thus if much flavone is produced, then little anthocyanin is formed. The same phenomenon occurs in other plants. Anthocyanin intensity, therefore, may depend to a considerable extent on the presence or absence of flavones

Changes in the hydrogen ion concentration of the sap have long been known as one cause of flower colour variation. Differences in the specificity of the anthocyanins constitute another. In view of the universal distribution of flavones, it seems probable that they will be found to comprise an important and hitherto unrecognised source of variation in both flower colour and intensity. A full account of these experiments will be published elsewhere

W J C LAWRENCE

John Innes Horticultural Institution,  
Merton Park, London, S W 19,  
April 30

<sup>1</sup> Robinson, G M, and R Robinson, *Biochem. J.*, **25**, 1687, 1931

### Science and Disarmament

AN article in *NATURE* of April 4, 1931, pointed out the connexion between science and the preparator for war, in reference to Major Lefebure's book "Scientific Disarmament". I understand from friends of mine, who are scientific workers, that in all countries some men of science regard as important the problem of their own moral responsibility for the use of scientific knowledge in preparation for war. Deliberate application of science in the development of armaments is transforming the nature of weapons and the general character of war. As Major Lefebure has shown, the gravest problem is the development of new types of weapon, and yet neither the official policies of governments nor the proposals of unofficial bodies seem to envisage this problem

Would it not be possible to form a small group of chemists, physicists, and other scientific workers of standing, in Great Britain—and also in France, Germany, and the United States—in order to make some public statement against the application of research to the improvement of gunnery, bombing, and chemical warfare? Such a statement would have influence in directing the minds of students of science towards their moral responsibility for the use of new knowledge, and the Disarmament Conference, now in session at Geneva, would be assisted if scientific workers, who provide the means for increasing the destructiveness of war, were to indicate publicly the gravity of the danger. It is obviously quite useless to abolish old armaments, if new and more deadly types of weapon are to be produced by the application of scientific research to such an end

C DELISLE BURNS  
(Stevenson Lecturer in Citizenship)

University of Glasgow,  
May 16



## Research Items

**Mummers' Plays**—Mr H Coote Lake has published a study of English mummers' plays with reference to the *Sacer Ludus*, in *Folklore*, 42, No 2. The mummers' plays are performed by villagers and others over the whole of England, the south of Scotland, and the north of Ireland, but there is no standard version and all sorts of perversions have crept in. A large number of versions—one collection contains thirty-three—have been printed, and probably many more have not been collected. Although they differ verbally and incidentally, the essential structure is the same, conforming, it is suggested, to the formula of an old European ritual dance or *Sacer Ludus*, a primitive magic rite in which the death and resurrection of summer was acted, in order that, as the actor who took the part of summer was slain and revived, so the summer, which had been slain by winter, might be revived. The comic doctor, who revives the hero, is a characteristic feature of the English play, and also appears in a folk play of Thessaly. He is a survival of the primitive medicine man. The Turkish knight, who in the English play fights with St George, is represented in the Thessalian version by a character with a black face who molests the bride and slays the bridegroom. He is often thought to be derived from a dark character representing winter. A Thracian play represents a blend of a mummers' play and the Plough Monday celebration. In a considerable proportion of the plays there is a 'recognition' of the dead man, which dramatically is unnecessary. If, however, the mummers' play is to be identified with the mimetic rite, this recognition becomes the very germ of the drama.

**Marriage Conditions in Palestine**—Dr Hilma Granqvist has made a close and detailed study of marriage in the Mohammedan village of Artās over a period of three years between 1925 and 1931, of which the results have been published by the Societas Scientiarum Fennica, Helsingfors (*Commentationes Humanarum Litterarum*, 3, 3). Dr Granqvist's method has been to work by concrete examples, and she quotes her informants' words in verbatim translation, so that her information and deductions may be checked against one another. The subject is studied under three heads: age of marriage, choice of a bride, and marriage by consideration. The births of a boy and of a girl are greeted with a blessing on the 'bridegroom' or 'bride' as the case may be, and it is a usual practice for the girl thereupon immediately to be bespoken by the father of a boy. Provided the boy, or his parents on his behalf, make the customary gifts at the great feasts in after years, this promise, which has been guaranteed by witnesses and ratified by the gift of a handkerchief or the like and a present of money to the bride's father, is never broken, unless in exceptional circumstances. The marriage takes place at an early age—formerly even before puberty, until government action intervened. One of the reasons for early marriage which carried great weight was the fact that the Arabs have no female servants and it was desirable that the mother of the household should have additional female help. It also afforded the mother-in-law an opportunity to mould her son's wife to the ways of herself and the family. The marriage of the children of two brothers was the type of alliance most favoured, the interests of the family or clan being best served by such a marriage. The fathers arranged the marriages, and individual choice or love played no part.

**A Red Indian 'Buffalo Drive'**—In the ages before the domestication of cattle and the cultivation of

crops, an outstanding problem for the ill-armed hunter must have been the provision of the community's food supply. Special interest, therefore, is attached to devices for supplementing the food-supply, particularly where they involve co-operative action or careful planning. Both are commemorated in an ancient Indian 'buffalo drive' on Ox-Bow Ranch on Strickland Creek, not far from the boundary of Yellowstone Park. It was used perhaps only two or three hundred years ago, but the fifteen hundred stone arrow-heads found at the spot indicate a people whose culture was still that of a stone age. The drive was formed by two lines of stone piles approximately a quarter of a mile apart at the open end and converging over a mile of prairie until they ended some fifty feet distant from each other. The bison were herded into the open end and constrained to follow the smooth track between what seemed to them natural barriers, and these instead of terminating in a circular pound as was usually the case, ran sheer to the edge of a precipice in the lava rock, over which the stampeded herd rushed to its doom. The distribution of stone arrow-heads beneath the cliff showed how the Indians finished off the maimed animals. A steatite bowl and the arrows from the excavations made on the spot by Barnum Brown and his party (*Natural History*, vol 32, 1932, p 75) indicate that the hunters were the Shoshone Indians and not the Blackfoot tribe which inhabited that territory at the advent of white men.

**Salmon of the West Coast of Scotland**—The extensive investigations made by the Fishery Board for Scotland into the life-history of the salmon have been devoted mainly to the rivers of the east coast. Observations made in the Grimeista district in the Isle of Lewis indicated that a significant difference might be found in the biology of the salmon on the west coast. Accordingly, a number of examinations have been made by Mr P R C Macfarlane of salmon from the River Dee in Kirkcudbrightshire in the years 1928 and 1929 (*Fisheries, Scotland, Salmon Fish*, 1931, No 2). The results indicate that there is slightly more growth shown by the west coast fish in their first year in the sea than by the east coast fish. This is taken as a possible indication that salmon from the two coasts of Scotland frequent different feeding grounds in the sea, and do not migrate to a common ground in the ocean. The parr from the river under survey also showed a considerably greater growth than do those of the Spey and Aberdeen-shire Dee.

**Chromosomes of *Sorghum***—In a study of the somatic chromosomes of the genus *Sorghum*, Prof C L Huskins and Mr Stanley G Smith (*J Genetics*, vol 25, No. 2) find that the wild species and cultivated varieties examined all have twenty chromosomes, except the Johnson grass, *S. halepense*, which has forty. All, without exception, have a single pair of A chromosomes of peculiar character. The cultivated sorghums came from tropical Africa, while *S. halepense* is Mediterranean. Since it has but one pair of A chromosomes, it is probably an allotetraploid, having arisen from a cross between a diploid *Sorghum* and some other genus without an A chromosome. The evidence indicates that all the diploid wild and cultivated species of *Sorghum* will cross readily, while there is great difficulty in crossing Johnson grass with the diploid forms, and the progeny from such crosses are almost sterile. In the root tips examined, a number of tetraploid segments and one

octoploid segment were found in diploid roots. The general results are in accordance with and confirm the views already held by systematists regarding the relationships of these forms.

**Loch Doon 'Granite' of Galloway**—The igneous complex of Loch Doon has been described by C. I. Gardner and S. H. Reynolds (*Quart. J. Geol. Soc.*, 1932, pp. 1-34). The authors find that the plutonic rocks range from true granites in the central ridge to norite at certain parts of the margin, the major portion of the mass being tonalite. These three types seem to be the result of three successive intrusions in order of decreasing basicity. Numerous minor intrusions penetrate the complex and the sedimentary rocks surrounding it. They include relatively large bodies of hybrid or dioritic character and small dykes of porphyrites and mica-, hornblende-, and augite-bearing lamprophyres. Some of the dykes, however, are metamorphosed and thus appear to be pre-plutonic. Metamorphism of the sediments has resulted in the production of mica-cordierite-hornfels. The spreading out of the metamorphic aureole to include the Burnhead mass indicates an underground extension of the plutonic rocks at no great depth, and suggests that the mode of emplacement of the complex may be laccolithic.

**The Humboldt Current**—The generally accepted explanation of the Humboldt Current of the Pacific coast of South America, as being derived mainly from the westerly drift of the Southern Ocean and only partly by upwelling of cold water, is questioned by the researches of the R. R. S. *William Scoresby*. In a note in the *Marine Observer* for June, it is recorded that this ship was engaged in surveying the Humboldt Current during the winter of 1931. The current was not found, at that season, south of Valparaíso, which seems to dispute the view that the surface drift of the Southern Ocean feeds it, and favours the secondary cause, namely, the upwelling of cold water due to prevailing south-east and southerly winds. The current reaches its maximum width and greatest strength, about twenty-five miles a day, off Peru. It finally disappears about five degrees south of the equator, underneath the warmer waters of the El Niño current that sets south. The El Niño waters occasionally pass inside the cold Humboldt waters, with disastrous consequences to the climate of Peru. It must be remembered, however, that the Humboldt Current has always been known to be very variable from year to year, and its seasonal fluctuations take it well south of Valparaíso in summer and even in winter, but at that season at a considerable distance from the coast.

**Air Movement and Weather**—Sir Napier Shaw has contributed a paper entitled "St. Martin's Summer in England in 1931" to *Beiträge zur Physik der freien Atmosphäre* (Band 19). It was written in commemoration of the birthday of V. Bjerknes, whose name is familiar to meteorologists mainly on account of his important contributions to dynamical meteorology. The extraordinary spells of unseasonable warmth that occurred during the last two months of 1931 were due largely to the occurrence of long spells of southerly or south-westerly wind of subtropical if not of tropical origin; this paper discusses a part of this period centring around Nov. 3. It is shown that the gales experienced in the south-east of England on that day travelled from west of Portugal in 24 hours, that the motion of the air stream underwent acceleration, and that the adjustment of horizontal pressure gradient to velocity at once took place. This air-stream reached Scandinavia and Finland a day later.

There was nothing very abnormal in the circumstances attending these events, the value of the paper lying chiefly in the discussion of the dynamics of moving air that centres around them. Sir Napier's views on these matters, particularly in regard to the greater importance to be attached to the air movement than to the distribution of areas of high and low pressure to which the movement gives rise, have nowhere been more clearly expressed. It is shown that under the conditions existing in an atmosphere that is almost unconfined, the energy represented by the pressure distribution is of secondary importance in atmospheric circulations.

**Demonstration of Wave Groups**—A description of an apparatus for explaining the nature of wave groups has been sent us by Dr. D. B. Macleod of Canterbury College, Christchurch, New Zealand. A circular aluminium disc of about 20 cm. diameter was hollowed out and a sine wave cut on the inner portion so that a given number of waves fitted into the circle. A second disc was left solid, and a wave cut on the outer edge. The discs were then mounted, one in front of the other, and rotated at a speed great enough to eliminate flicker. Arrangements were made so that the speed of each could be varied separately. The discs were illuminated by a beam of parallel light from a lantern, and thus silhouetted on a screen. A wave group then appeared on the screen, and its velocity, forward or backward, could be controlled by adjusting the speeds of rotation. The number of waves on a disc may be so few as one, the curve then being a cardioid, or so many as eight or nine. The apparatus can be used to make clear many properties of wave groups, and, by suitably choosing the number of wave-lengths on each disc, can be made to give general ideas of the application of these properties to the electron and to quantum orbits.

**Superconductivity for Alternating Currents**—The work of Prof. J. C. McLennan and his associates on superconductivity at high frequencies (*NATURE*, Dec. 12, 1931, p. 1004) has now been described more fully (*Roy. Soc. Proc.*, May). Measurements were made on lead, tin, and tantalum by the reactions of oscillatory circuits made of these, and immersed in the refrigerant, on a tuned oscillator outside the Dewar flask. The effect of using the high-frequency current instead of direct current is twofold: the abruptness of the transition from ordinary conduction to superconduction as the temperature is progressively lowered is markedly diminished, and the temperatures of both onset and effective completion of superconduction fall. With increase in frequency, the transition temperature becomes lower, and it is calculated by extrapolation of the experimental results for tin that the transition would not occur until the absolute zero was reached for a frequency of about  $10^9$  cycles per second. The apparent failure of metals to become superconductors at sufficiently high frequencies is supported by the fact that no evidence of an abrupt change corresponding to superconductivity has ever been observed with light waves. A number of additional experiments which had to be performed to verify that the frequency effect was not due to some subsidiary cause are also described.

**The Red Nitrogen Band Spectrum**—The partial analysis of the rotational structure of these bands by S. M. Naudé (*Proc. Roy. Soc.*, May) is interesting both for the information which it furnishes about the nitrogen molecule and for the time during which these bands, which are amongst the best-known of spectra, have defied complete analysis. Even now, only a section of the system, in which there is com-

paratively little overlapping, has been analysed, an idea of its complexity being given by the fact that a resolving power of 180,000 was not sufficient to show all the existing fine structure. Each band consists of three groups of nine branches, the electronic transition being of the  $^3\Pi-^3\Sigma$  type, and the usual information has been derived from the data for the size and other properties of the molecule. Consecutive lines of the branches have alternating intensities in the ratio of approximately two to one, thus showing that the nitrogen nucleus is spinning with unit angular momentum, a conclusion which has also been reached from the study of some bands of the ionised nitrogen molecule. In making this analysis, much assistance was obtained from the quantum theory of molecular structure, which, as with atomic spectra, permits of prediction of the types of terms and, for molecules, the details of rotational structure likely to be encountered.

**Artificial Production of a Penetrating Nuclear Radiation.**—Mr. Webster's observations on the secondary radiation produced in beryllium and other light elements by bombardment with polonium  $\alpha$ -particles (*Roy. Soc. Proc.*, May; see also *NATURE*, March 12, p. 402) are an excellent example of the type of work which is usually required now to obtain new knowledge of atomic nuclei, and has only become possible through recent advances in technique with special precautions to eliminate spurious effects. The low efficiency of production of the secondary radiation, which ranges from 0.5 quanta per million  $\alpha$ -particles for magnesium to 30 quanta for beryllium, is here aggravated by the small ionising power of the product; the intensity of the effect ultimately measured when this is cut down by screens to measure its penetrating power is very small indeed. A strong  $\alpha$ -particle source is necessary, and the measurements must be made in a place free from serious radioactive

contamination. Two detecting instruments, both highly sensitive, have been used, a Geiger-Müller tube counter and a high pressure ionisation chamber, the latter being usually preferred. The counter does not appear to be fulfilling the high expectations it aroused when it was first devised—at least in the form usually employed—and is usually described as somewhat erratic in action. The full interpretation of Mr. Webster's results must remain uncertain, until it can be decided how much of what he has observed is due to neutrons and how much to  $\gamma$ -rays, but his extensive experiments will certainly serve as a sound basis for future work.

**Biological Test for Rhamnose.**—Aldo Castellani and F. E. Taylor in 1917 described a 'mycological' method for the identification of various sugars and other carbon compounds, based upon the fermentations exerted on these substances by diverse species of *Monilia*. Castellani now describes a bacillus which ferments rhamnose with gas production, but does not produce gas from twenty-eight other substances tested; these included eight other sugars, six alcohols, two glucosides, inositol, dextrin, inulin, and several starches (*Ann. de l'Institut Pasteur*, T. 47, p. 297; 1931). This bacillus, obtained from human faeces, is a small aerobic, non-spore, non-motile, Gram-negative organism which is named *B. rhamnosifermentans*. If this organism ferments a solution which reduces Fehling's solution, in all probability it contains rhamnose. The method employed is to prepare a sterile one per cent solution of the substance to be tested in peptone water in a Durham's fermentation or other tube, inoculate with the *B. rhamnosifermentans*, and incubate at 37° C. for four days; gas production indicates the presence of rhamnose. Suggestions are given whereby a mixture of sugars, etc., might be identified by the use of this and other fermenting organisms.

### Astronomical Topics

**Detection of Kopff's Comet.**—Another of the numerous periodic comets due this year has been detected. Mr. Bobone found Kopff's comet at Cordoba (Argentina) in the following position:

|                  | R.A. (1932-0).                                    | S. Decl.    | Mag. |
|------------------|---------------------------------------------------|-------------|------|
| May 25-0788 U.T. | 15 <sup>h</sup> 11 <sup>m</sup> 18.8 <sup>s</sup> | 26° 11' 12" | 12   |

It is rather brighter than was expected. The concluded date of perihelion is Aug. 21.40 U.T.; this is 0.24<sup>d</sup> later than Mr. Kepinsky's prediction, and 1.08<sup>d</sup> later than Mr. Cripps's in the "B.A.A. Handbook". This comet was discovered in 1906, and seen again in 1919 and 1926.

**Cometary Observations at Yerkes Observatory.**—Prof. G. van Biesbroeck gives much attention to observations of comets, chiefly by photography with the 24-inch reflector. *Harvard Card* 189 contains a series of observations of Nagata's comet made by him during February, more than eight months after perihelion. It was of magnitude 15½ and had a faint coma, 25" in diameter, with a central condensation. The positions indicate that the period of 267 years, found by Crommelin in the autumn, is somewhat too short, but the orbit is definitely elliptical, with a period of a few centuries.

A telegram distributed by the I.A.U. Bureau, Copenhagen, announces that Prof. van Biesbroeck detected Grigg-Skjellerup's comet on March 6 at 1<sup>h</sup> 30.3<sup>m</sup> U.T. Its position for 1932-0 was R.A. 5<sup>h</sup> 31<sup>m</sup> 49.3<sup>s</sup>, S. Decl. 5° 3.0'. Magnitude 16. This is the fourth observed apparition of the comet, the others being 1902, 1922 (when its periodicity was dis-

covered), 1927. As the period is very close to five years, the circumstances of each return are nearly the same.

**Distribution of Stellar Luminosities.**—The distribution of absolute magnitudes for stars brighter than magnitude 6.0 has been investigated by Strömberg in a series of papers in the *Astrophysical Journal*. These have dealt separately with groups of stars within narrow limits of spectral type, using a valuable new statistical method which employs peculiar motions, parallactic motions, and radial velocities. He now summarises his previous results (*Astrophys. J.*, 75, 115) and brings together on one diagram the luminosity curves for all the different spectral types. Several very interesting features which had been suggested in the earlier investigations now appear more definitely in the assembled results. The distinction between normal giants and dwarfs (or 'main sequence' stars) is, of course, evident; but the existence of an intermediate group ('faint giants') also appears for the types  $M_0$  to  $F_0$ . At type A all these three groups merge together and carry on the main sequence to a maximum luminosity of -2.9 for early B stars. On the side of greater luminosity, two other fairly well defined sequences occur, termed respectively 'bright giants' and 'super-giants', which are found throughout nearly the whole spectral range. The latter attain absolute magnitudes as bright as -8 for early B stars. The gap between bright giants and normal giants is very definite, and the author suggests that this may represent a region of instability connected with cepheid variation and outbursts of novæ.



### The Mond Photographic Equatorial of the Norman Lockyer Observatory

ON Saturday last, May 28, in the presence of a distinguished assembly, Sir Frank Dyson, Astronomer Royal, opened at the Norman Lockyer Observatory, Salcombe Hill, Sidmouth, a new building containing a unique photographic equatorial presented to the Observatory, together with the dome and building itself, by Dr. Robert L. Mond. The Observatory was founded nearly twenty years ago by Sir Norman Lockyer and Sir Francis McClean, and it first bore the name of the Hill Observatory. It was afterwards formed into a corporation under the Companies (Consolidation) Act of 1908, and Norman Lockyer's name was given to it as a memorial of the great work done for science by that renowned astronomer.

The site of the Observatory, at a height of 560 feet on the top of Salcombe Hill, and with an unbroken horizon in every direction, was presented to the Observatory by Sir Norman and Lady Lockyer. Hitherto, the two main instruments have been a twin telescope with object glasses of 12 and 10 inches aperture, presented by Sir Francis McClean, and a telescope of 10 inches aperture, presented by Sir Norman Lockyer. Each of the two telescopes is fitted with a prismatic camera—one 12 in. and the other 9 in.; and the Observatory now possesses a collection of 6458 spectra taken with these cameras. From the beginning, the Observatory has been built, equipped, and maintained entirely by private contributions, and one of its most generous supporters is Dr. Mond, who has now added to his gifts the new photographic equatorial illustrated in Fig. 1.

The construction of this instrument was suggested by the director of the Observatory, Dr. W. J. S. Lockyer, and the work has been carried out by Messrs. Cooke, Troughton and Simms. Dr. W. H. Stevenson made a thorough optical examination of the Zeiss lenses selected for mounting to form the photographic battery, and he afterwards again visited the Observatory to complete the very accurate adjustments required of the optical axes of the lenses in relation to the planes of the photographic plates. The following are extracts from his report on the new telescope and the kind of work it is capable of doing:

"The instrument has been designed for the photography of relatively large regions of the sky on a small or moderate scale. This particular class of instrument may be said to have been introduced by the late Prof. Barnard, and to have its prototype in the famous Bruce photographic equatorial, designed by him and used for his well-known photographs of the Milky Way. As will be seen, the Mond equatorial is in many re-

spects similar to the Bruce. Details of the optical equipment are shown in this accompanying table:

|    | Lens.            | Focal Length.<br>Cm. | Aperture.<br>Cm. | Size of Plate.<br>Inches. | Area Covered in<br>Degrees. | Scale of Plate<br>per Inch. |
|----|------------------|----------------------|------------------|---------------------------|-----------------------------|-----------------------------|
| 1. | Zeiss Triplet    | 120                  | 17.1             | 10 × 12                   | 14 × 12                     | 1.1"                        |
| 2. | Zeiss Triplet    | 70                   | 14.0             | 8½ × 6½                   | 17 × 13                     | 2.1"                        |
| 3. | Zeiss Triplet    | 50                   | 10.4             | 6½ × 4½                   | 18 × 13                     | 2.9"                        |
| 4. | Zeiss Anastigmat | 25                   | 7.0              | 5 × 4                     | 30 × 24                     | 6.4"                        |

There is also a 4-inch guiding telescope fitted with double sliding eye-end with bright and dark illumination to field.

"The equatorial mounting, which is of the German

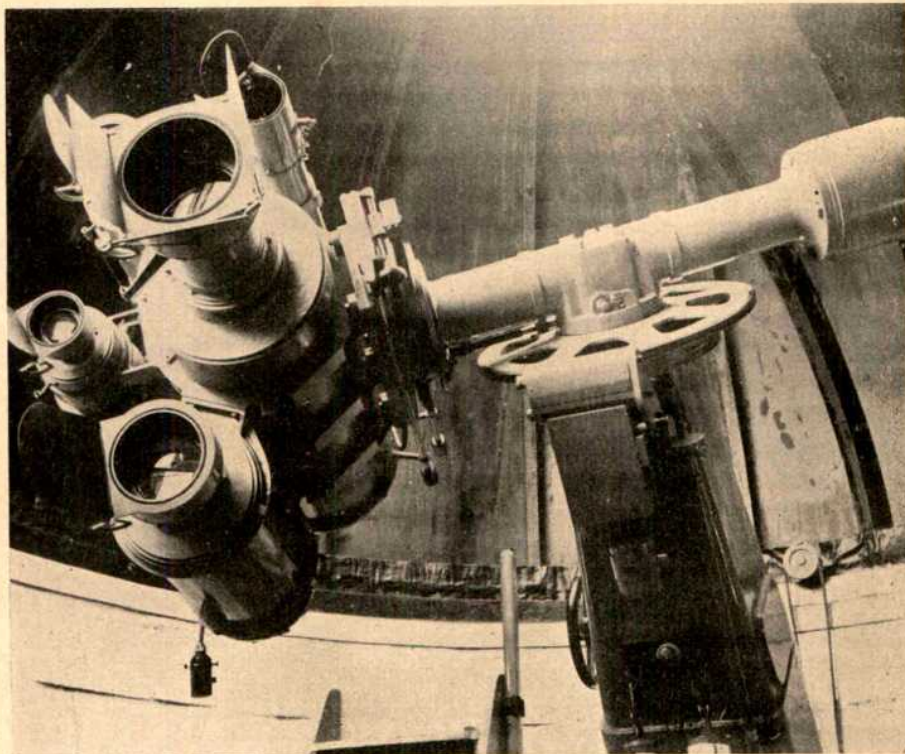


FIG. 1.—The Mond Photographic Equatorial.

type, is of very massive construction, the lower half of the mounting weighing 1 ton 6 lb. That part of the casting which holds the polar axis overlaps the vertical portion very considerably, as in the Bruce mounting. This allows of complete and uninterrupted circumpolar motion at all declinations. The driving circle is very accurately cut, and is of generous proportions, its diameter being 27½ inches. The polar axis is mounted in ball bearings, and the whole instrument, when unclamped, will move at the lightest pressure of one finger.

"Setting in R.A. can be done very comfortably from floor level, the circle being let into the south side of the mounting and geared to the lower end of the polar axis. This circle is divided to five minutes of time, and the Declination circle to single degrees. Both circles are read by simple pointers, verniers and fine divisions being unnecessary for this type of instrument.

"The clock, which is driven by a weight falling in

a steel frame outside the Observatory, will run for about  $2\frac{1}{2}$  hours without re-winding. It is controlled electrically by a seconds pendulum mounted in the vestibule. Slow and rapid motions in R.A. are provided by means of a specially geared electric motor, working on the driving-worm independently of the clock.

"In recent years several American and continental observatories have added small-scale photographic instruments to their equipments, but it is believed that the Mond equatorial is the first of its kind to be erected in Great Britain.

"The uses to which the instrument can or will be put include the photography of meteors, comets, and large nebulosities of the galactic type. In addition, the search for new minor planets, comets, variable stars, and novæ can be undertaken with such an apparatus with a greater hope of success than where an instrument of greater power but smaller field of view is used. Even unsystematic work with this battery of cameras may be of considerable ultimate value."

At the opening ceremony, Sir Richard Gregory, chairman of the Council of the Observatory, said he hoped that the wide and intelligent public interest now shown in astronomical subjects would lead to increased support for the Observatory, in which valuable work in astronomy is being carried on with instruments and funds provided by private donors, and without the aid or control of State or other official institutions. Private benefactions have provided the United States with the finest observatories in the world, with the result that we owe to American astronomers some of the most important observations made in recent years in solar and stellar astronomy, particularly in the field of astronomical physics. It is perhaps too much to expect similar munificent support for astronomical research in Great Britain, but it ought not to be too much to hope that an observatory like that on Salcombe Hill, in which many notable contributions to

progressive knowledge have been made, should be placed in such a financial position that the maintenance of its activities will be ensured.

In the course of his remarks, Sir Frank Dyson said: "It is now ten years since I had the honour of unveiling here the tablet to Sir Norman Lockyer. There can be no doubt that his spirit pervades the Observatory. Constant observation seems to be the rule, and there are more fine nights here than we have at Greenwich. Dr. Lockyer produces for us with regularity valuable papers on stars with bright hydrogen lines. He is making constant observations of stars in which the intensity of the components of these lines varies. A star in Camelopardalis, Bradley 448, he observed through the entire cycle 1925-30 of its variability. He has also discussed  $\phi$  Persei and a number of other stars, and has discovered a number of new stars with bright hydrogen lines. Mr. Edwards is repeatedly bringing out spectroscopic parallaxes of early type stars. The influence of the Observatory is felt as far away as Canberra, where Mr. Rummer is carrying on valiantly under difficult financial conditions. I am quite sure Sir Norman would have been delighted to see how the work, in which he was so greatly interested, is being developed."

Dr. R. G. Atkin, director of the Lick Observatory, said that he always read with great interest the papers describing the spectroscopic and other observations and results achieved at the Observatory, and he congratulated the Council upon the addition of a most useful instrument to its equipment. Dr. Mond, in his reply, referred to his long association with Sir Norman Lockyer and Dr. Lockyer, and said that he regarded the new instrument as an astronomical 'robot' which would faithfully record celestial appearances and events over wide fields of view while the staff of the Observatory was carrying on the routine spectroscopic work on individual stars, and the photographs thus obtained would be of permanent value for astronomical reference and discovery.

### International Committee of the History of Science

THE fourth annual conference of the Comité International d'Histoire des Sciences was held in Paris on May 13-16, under the presidency of Prof. Karl Sudhoff. Among those present were Mme. Hélène Metzger, Prof. P. Diepgen, Prof. F. Faddegon, Dr. E. J. Holmyard, Prof. Louis Massignon, Prof. Aldo Miel (permanent secretary), Prof. E. Mittwoch, Prof. A. Raymond, and Prof. D'Arcy W. Thompson. The meetings were held at the Centre international de Synthèse (12 Rue Colbert), and, apart from formal business, were devoted entirely to the history of the sciences in medieval Islam. The president, Prof. Sudhoff, read a paper on Constantine, the first to transmit Muslim science to the West, and described the part played in this transmission by Maurus and Urso, two early schoolmen of Salerno. Prof. Massignon, in a brilliant discourse, pointed out the contrast between Greek and Muslim conceptions of numbers, and suggested the importance of Manichaean ideas in early arithmetic.

The present state of research into Arabic mathematics, astronomy, and physics was fully described in a report by Prof. Faddegon, and similar reports on geography, cartography, and medicine were presented by Profs. Ferrand, Renaud, and Mittwoch. The chairman of the sub-committee for Arabic studies, Prof. Julius Ruska, was unfortunately not able to attend the conference, but his report on Arabic alchemy was read by Prof. Diepgen. Though much has been done in recent years, particularly on the Jabir problem, the Emerald Table of Hermes, and the Turba

Philosophorum, it was evident from Prof. Ruska's report that the full elucidation of Muslim alchemical ideas and practice will require many years of intensive effort. In the course of the discussion, it was suggested that an urgent need is the detailed investigation of the numerous works of Andamun al-Jildaki, while a catalogue of Arabic alchemical manuscripts in Spain is greatly to be desired. The possibility was mooted of establishing a central card index of Arabic technical and scientific terms, to supplement the meagre information on this subject contained in the standard dictionaries of Lane, Dozy, etc. A collateral index of alchemical and other signs was also considered desirable.

A further problem that the Comité regards as worthy of close attention is the assessment of the influence upon Muslim scientific thought of the doctrines of Gnosticism, Neoplatonism, and Manichæism, the latter in particular, according to Prof. Massignon, has left very distinct traces in Muslim alchemical theory. The question of the systems of transcription of Arabic words gave rise to considerable difference of opinion, but it was generally felt that no single system is likely to attain universal adoption, however desirable such uniformity may be.

On Saturday, May 14, members of the conference were given a delightful reception at the Sorbonne, by the Institut d'études islamiques and the Institut d'histoire des sciences. The next annual meetings of the Comité will be held at Warsaw (1933) and Berlin (1934).



## The Provincial Universities of Great Britain

IN the October (1931) issue of the *Universities Review*, Prof E R Dodds opened a discussion on the question, "What is Wrong with the Modern Universities?" Further articles in the April issue carry the matter on another stage. These outspoken essays are in general agreement as to there being ample grounds for the implied assumption of failure to realise an ideal, and incidentally testify to the value of Dr Abraham Flexner's recent work, "Universities American, English, German", in stimulating thought on the subject.

Most students of the modern universities are, according to Prof W M Tattersall, whose presidential address to the Association of University Teachers is reproduced in the April issue of the *Review*, uncivilised and, in a broad sense, uneducated. They are conspicuously lacking in that *bildung* which Flexner holds to be characteristic of the product of the ancient universities. Prof Tattersall attributes this largely to the fact that only a small percentage of the students are able to live in colleges or hostels, the larger number living either at home or in lodgings. Pending or failing the provision of a complete and compulsory residential system, an organised effort should be made to promote informal and social contacts between staff and students. He suggests, and the scheme is not without precedents, that the students should for this purpose be allotted in groups to members of the staff, each of whom would act in the capacity of 'moral' tutor to the group assigned to him (or her).

In an article headed "University Uniformity", in the same issue, Prof R C McLean observes that the root of the trouble with our local universities is that they are so intensely local. He is in favour of spells of wage-earning during the study years and migration between universities. Two other articles discuss the same problem with special reference to the large proportion of the students of the modern universities who are destined for the teaching profession.

The teacher-training departments occupy in the modern provincial universities a position peculiarly favourable for estimating the effects of the educational processes at work in the arts and pure science departments. The diploma course of these departments includes graduates from many different schools of the university, and while pursuing it they show 'the mettle of their pasture'. It is fitting, therefore, that there should be two articles by members of the staffs of teacher-training departments, namely, Profs F A Cavenagh and J F Duff. Both are of opinion that students suffer from being over-taught in the effort to cover the whole of the ground defined by an elaborately prescribed syllabus, with the result that they have little time for spontaneous learning.

Since lectures cannot be dispensed with or the lecture programme greatly reduced while the students are so numerous in proportion to the staffs, the remedy, suggests Prof Cavenagh, lies in improving the lectures. Too many university teachers give but little thought to their teaching as an art in itself, regarding skill in teaching as something that comes by itself or is beneath the notice of a competent scholar. The 'research' fetish, moreover, has largely ousted the ideal of the well-educated, well-read student with more than one intellectual interest. Both articles direct attention to the evil results that follow in many cases the choice by students of a highly specialised course merely because it seems the only avenue to the goal of a 'good honours degree', notwithstanding that a less specialised course would be more congenial and of greater practical utility.

## University and Educational Intelligence

CAMBRIDGE—The Managers of the Balfour Fund have made the following grants: (1) £100 to I T Sanderson, of Trinity College, for an investigation of the land vertebrate fauna of the Cameroons; (2) £30 to D L Serventy, of Gonville and Caius College, for a biological survey of the East Anglian estuaries.

W E Candler, scholar of Trinity College, has been elected to the Sheepshanks Exhibition.

The Council of the Senate recommends that the readership in ethnology be discontinued, and that there be established a William Wyse professorship of social anthropology, which shall be held in the first instance by Col T C Hodson, of Christ's College.

The General Board recommends that the subject of pharmacology be placed under the superintendence of the professor of physiology in the Department of Physiology, and that the University lectureship in pharmacology be transferred from the Faculty of Medicine to the Department of Physiology in the Faculty of Biology B.

The Board of Research Studies has approved Mr U R Evans, of King's College, for the degree of Sc D.

A Research Studentship at Emmanuel College, of the maximum annual value of £150, will be awarded in July. Preference will be given to candidates who have already completed one but not more than two years of research. Applications, including a statement of the proposed course of research, must reach the Master, Emmanuel College, Cambridge, not later than June 30.

OXFORD—On May 24, Congregation passed a decree acknowledging with gratitude the offer of the Rockefeller Foundation to contribute a sum not exceeding 2,300,000 dollars, together with an additional 10 per cent of the estimated cost of construction, towards the extension of the Bodleian Library, on condition that the University shall have received for the same purpose a total of £377,720 before the end of 1936. In proposing the adoption of the decree, the Warden of New College mentioned that the scheme included the addition of a new wing to the Radcliffe Science Library at the Museum.

THREE post-graduate scholarships in pure and applied science are being offered by University College, Nottingham. The value of each is £100, and they are tenable for one or two years. Forms of application, returnable by July 21, can be had from the Registrar of the College.

## Calendar of Geographical Exploration

June 5, 1594—Barents in the Arctic

A Dutch expedition, with William Barents (Willem Barentszoon) in charge of one ship, the *Mercuurius*, sailed from Texel to search for the North Sea route to the east. Barents on this voyage discovered and explored the northern part of Novaya Zemlya. Two of the other vessels that left the Texel on that date were in charge of Jan Huyghen van Linschoten, a distinguished Dutch mariner, and they penetrated into the Kara Sea. Linschoten's report resulted in the sending of a second Dutch expedition in 1595, which, however, was compelled by ice and contrary winds to return when it had barely entered the Kara Sea. A third Dutch expedition, this time organised by the city of Amsterdam, sailed on May 10, 1596, with William Barents as chief pilot. They discovered Bear Island and part of Spitsbergen, which Barents, however, thought was Greenland. On returning to Bear Island, Barents sailed south and the other ship



north Barents and his party were compelled to winter at Ice Haven, the first record of western Europeans wintering in the arctic. They suffered severely, though a lucky find of driftwood prevented them from dying of cold. In early June they started their return journey, their boats being in constant danger from floating ice. Barents, enfeebled by his winter hardships, died, but de Veer brought the vessels home in November 1597, being much helped by meeting the companion ship which had left them at Bear Island and now brought them supplies of food.

#### June 5, 1866 — Valley of the Mekong

An expedition sent out by the French Government left Saigon to explore the Mekong, Doudart de Lagrée being in command and F. Garnier accompanying him as geographer. They went up the Mekong to Pnom-Penh and examined the ruins of Angkor. Thence they reached the confluence of the Se-khong, which was examined as far as Siempang. Bassac was made a centre for expeditions to the Boloven plateau, the Se-don, and the divide between the Se-don and the Se-khong. From Bassac they continued up the Mekong to the Se-mum, and from Ubun, on that stream, Garnier made an overland traverse through Siemreap to Pnom-Penh. After other expeditions, the party reached Chieng Kong, but could proceed no farther because of rapids. They went north-east, and reached Yunnan on Dec. 21. De Lagrée died before the expedition ended, but Garnier made his way to the Yangtse-kiang and returned by sea to Saigon. This journey is memorable alike for the immense amount of new country opened up and for the wealth of geographical, ethnological, and economic data collected and afterwards published.

#### June 7, 1576 — Rediscovery of Greenland

Martin Frobisher sailed from the Thames in search of a north-west passage to China, the effort being a result of a pamphlet published by Sir Humphrey Gilbert arguing that such a passage must exist. On July 11 he sighted Friesland (Greenland), and in August reached 63° N., where he entered Frobisher Bay. He believed that this was the strait for which search had so long been made. Descriptions of the Eskimo and their customs are included in the narratives of this and subsequent voyages. Frobisher's interest in discovery was diverted to a search for gold in the region. On his second voyage in search of that metal he discovered, apparently accidentally, the channel now called Hudson Strait. Frobisher may be considered the pioneer of arctic navigation.

#### June 8, 1924 — Mt. Everest

G. L. Mallory and A. C. Irvine left Camp 6, altitude 26,800 ft., for their attempt on the summit of Mt. Everest, and N. E. Odell caught a glimpse of them before the mists enshrouded them. They never returned. Bad weather had been experienced on the march, and Norton, Somervell, and Mallory had, after heroic efforts, rescued four porters who had remained on the North Col and been cut off by a hurricane. Norton on June 4 had been attacked by snow-blindness, but Hingston and Hazard led the blind man successfully down the steep and difficult descent. A Gurkha officer and a Tibetan follower lost their lives. The attempts on Mt. Everest in 1921, 1922, and 1924 resulted in the survey of the Rongbuk glacier region, and in much new topographical information about the region. The work of Major R. W. G. Hingston threw much light on the struggles of animals to exist in high altitudes, while that of Heron and Odell contributed to the knowledge of the geology and glaciology of the region.

#### June 11, 1774 — Nootka Sound

Juan Perez sailed from Monterey in the *Santrago*, and reached lat. 55° N. On the return voyage he touched the harbour now known as Nootka Sound, in 49° 35', naming it San Lorenzo. In 48° 10' he sighted a peak which he called Santa Rosalia, the modern Mount Olympus.

ERRATUM — In NATURE of May 28, p. 805, the date of Livingstone's death is given as April 30, 1830, this should read April 30, 1873.

### Societies and Academies

#### LONDON

Royal Society, May 26 — E. V. Appleton and R. Naismith. Some measurements of upper atmospheric ionisation. Experimental work on the reflexion of wireless waves by the upper atmosphere has shown that if the frequency of waves, projected vertically upwards, is steadily increased, the Kennelly-Heaviside layer (Region E) is ultimately penetrated and reflexion takes place at the upper region (Region F). The critical penetration frequency varies diurnally and seasonally. From measurements of the critical penetration frequency made in south-east England, the maximum ionisation content of the Kennelly-Heaviside layer is at noon, and a minimum occurs just before dawn. The diurnal variation curves correspond very closely to the theoretical curves obtained by S. Chapman in his study of the atmospheric ionisation produced by a solar stream of monochromatic radiation. Summer noon ionisation is found to be about 2.5 times as intense as winter noon ionisation. — J. D. Cockcroft and E. T. S. Walton. Experiments with high velocity positive ions (1 and 2). In order to obtain high steady potentials for the acceleration of protons, a method has been developed by which the voltage of a transformer can be rectified and multiplied several times by an arrangement of valves and condensers. A rectifier system has been built consisting of four glass cylinders placed end to end and arranged in the form of a tower 12 ft. high, the cylinders containing suitable electrodes and hot filaments and being evacuated continuously. With this apparatus and four condensers, a potential of more than 700 kv. has been obtained, which is steady to within a few per cent. The method used is a special case of a more general method of transforming steady potentials from low to high voltages and in the reverse direction. The voltage of the rectifier is applied to an experimental tube which is built to allow positive ions to be accelerated by the full voltage available. Positive ions of hydrogen are directed down the axis of two glass cylinders and focused by suitable electrodes, current of the order of 10 microamperes being obtained. Protons having energies up to 710 kv. have been produced, and have been transmitted through a mica window into an experimental chamber at atmospheric pressure, where their ranges are measured (see also NATURE, April 30, p. 649).

#### PARIS

Academy of Sciences, April 18 — H. Douvillé. The formation of flints. The properties of colloidal silica suffice to explain the formation of flints, without the necessity of assuming a true solution of the silica. The same explanation may apply to pyrites. — C. Matignon, Dode, and Mlle. Langlade. Urea phosphate. Details of preparation, solubility, and hydrolysis of phosphate of urea,  $\text{CO}(\text{NH}_2)_2 \cdot \text{H}_3\text{PO}_4$ . — Louis Roy. The internal thermodynamic potential of an elastic

line with six parameters—Joseph Boucher A new, or slightly known, property of the radicles of germinated barley A suggested treatment for diabetes—Eugene Donard and Henri Labbe The existence in the malt dust of germinated barley of a substance possessing hypoglycæmic power and acting in a manner analogous with insulin The action was proved by experiments on rabbits—Long The geometric definition of a group of  $\Sigma$  surfaces—André Weil The series of polynomials of two complex variables—F Marty The second and third derivatives of a holomorph and univalent function in the circle unity—Alfred Rosenblatt The stability of the movements of Couette—Henri Porcin The stationary cavitations in a fluid in irrotational movement—J Peres and L Malavard Electrical analogies in hydrodynamics—Kivelisvitch The null velocities in the problem of three bodies—G Rougier A photoelectric photometer with amplification for the measurement of feeble illuminations The instrument is standardised by comparison with a stable light standard after each measurement, and has been applied to numerous observations on the moon—Émile Belot The origin and evolution of stars and amorphous nebulae, according to the dualist cosmogony—André Berthelot The unit of length employed in the first measurements of the earth's circumference From an examination of the data available, it is concluded that Posidonios and Ptolemy used the same unit of length as Eratosthenes, namely, the Egyptian stadium of 157.5 metres—Y Rocard Regulated valve oscillators—R Chevallier The magnetisation of ferromagnetic powders in weak fields—Th V Ionescu and C Mihul Free electrons of ionised gases in the magnetic field—Leon Dubar The constitution of the oxide of rectifiers and of photoelectric cells using cuprous oxide The rectifying layer has been submitted to examination by chemical, microscopical, X-ray, and electrical methods Cuprous oxide is a non-conductor, and the cause of the conductivity is disseminated throughout the mass in very small quantity This hypothetical cause of the conductivity, possibly  $\text{CuO}$ , can only be present as a solid solution or colloid solution—G Siadbei A new method of measuring very small angles of rotation The method is based on the reflexion from the curved surface of the air bubble in a spirit level An amplification of 400 is obtained—A Silveira The Raman effect in solutions of salts—J J Agarbiceanu The anti-Stokes term in the fluorescence spectrum—H Jedrzejowski An example of the mobility of radioactive atoms on the surfaces of solid bodies A study of the diffusion of polonium over the surface of platinum at various temperatures—Francis Perrin The existence of neutrons and the constitution of nuclei of light atoms—Pierre Auger The radioactivity of potassium—H Hering The heterogeneous equilibria in the system cadmium bromide, potassium bromide, and water—Martineau The oxidation of ethyl alcohol by air in presence of various binary or tertiary catalysts The catalysts used included charcoal-zirconia, charcoal-thoria, copper-cerium oxide, copper-thoria, and catalysts containing three constituents One catalyst containing carbon, thoria, and copper caused the production of aldehyde at the ordinary temperature—Raymond Buret Chlorine and phosphorus compounds derived from dibenzoylmethane—Mlle Madeleine Roy Cryoscopic researches on castor oil—Jacques Bourcart and Mlle Elisabeth David The series of Foraminiferous grits of Ouezzan (Western Morocco)—Y Milon The extension of Eocene siderolithic formations in the centre of Brittany—Thorai Tectonic outline of the eastern part of the Monts de Lacaune—P Fallot The connexions of the

series with Alpine facies identified between Sierra Sagra and Alicante—Albert Michel-Lévy The existence of pre-Cambrian formations in the Montagne Noire (Hérault)—R Bureau The daily variation of atmospheres at Paris, 1928-31 The respective influences of the sources and of the propagation—P L Mercanton The inversion of the magnetic inclination during geological epochs New proofs—Ad Davy de Virville The flora of the reefs of the roadstead of Saint-Malo—O Munerati The possibility of the beetroot producing seed the first year in Egypt and in other regions with a similar climate It is proved by experiment that a type with a marked tendency to seed the first year shows clearly the same tendency in regions where the production of seed the first year has never been proved before—A Maige The rôle of the plast and cytoplasm in the amylogen condensation—Paul Becquerel The latent life of the spores of mosses at low temperatures After 240 hours' exposure to the temperature of liquid nitrogen ( $-190^\circ \text{C}$ ) the moss spores all germinated with the same regularity as controls In further experiments on the dried spores of *Atrichum undulatum* and of *Dicranella heteromalla*, exposure for 9 hours in liquid helium at  $-269^\circ \text{C}$  and one hour at  $-271.16^\circ$  was found to leave the germinating power unaffected—Mlle A Dusseau A hybrid haplodurum resulting from crossing two *Triticum vulgare*—Jules Amar The coefficient of hydrothermal partition—Augustin Boutaric and Maurice Doladihe The principle of a physical method by means of which the transformations produced by dilutions in a serum may be followed—Neda Marinesco The effect of intense diathermy on plants—Maurice Nicloux The combustion of alcohol in the homeotherm The quantity of alcohol burnt in unit time, for unit weight of body is constant In white mice this constant is 0.65 mgrm per gram-hour—Henri Marcellet Oil of *Orthagariscus mola*, modifications due to parasites Abnormal proportion of cholesterol—G Warcollier and Aug Le Moal The accidental presence of acrolein in cider brandy—Mme S Lallemand The distribution of chloroform in the egg of the fowl in the course of the intoxication of the germ by this anæsthetic The order of magnitude of the cellular toxic dose—M Advier The existence in the blood of a convalescent plague patient of a principle breaking down Yersin's bacillus—R Pons and C Durieux The existence in the bubo of a convalescent plague patient of an agent of transmissible lysis, apart from its presence in the intestine—Ph Lasseur, M Pierret, A Dupaix, and C Maguitot Remarks concerning the correcting note of M Lakhovsky—Andre Pling Contribution to the study of the bactericidal power of metallic silver with respect to the typhoid bacillus and coli bacillus It is shown that metallic silver is slightly soluble in water (concentration of the order  $1 \times 10^{-5}$ ), and that this affords an explanation of its bactericidal action

## CRACOW

Polish Academy of Science and Letters, Feb 15—Lad Orlicz (1) A certain class of spaces of type  $B$ —(2) The theory of the differential equation  $y' = f(x, y)$ —(3) Contributions to the theory of orthogonal developments ( $Pt\ III$ )—C Zakrzewski and M Miesowicz Feebly damped short electric waves It has been known for some time that metallic tubes transform the damped electric waves produced by spark vibrators With tubes of different cross sections, short waves, only slightly damped, can be obtained The authors have been able to produce by this method waves of a wave-length of 50 mm—M Centnerszwer and J Szper The electrolysis of alkaline cyanides An attempt to put the prepara-

tion of the alkali metals by the electrolysis of the cyanides on a commercial basis—J Zawadzki and S Bretsznajder The course of the reactions between calcium oxide and sulphur dioxide and calcium oxide and carbon dioxide—J Tokarski New microscopic and chemical analyses of the phosphites from Grodno (Poland)—J Jarocki and Z Raabe Three new genera of Infusoria of the Hypocomidæ family (*Ciliata Thaumotricha*), parasites of fresh-water lamellibranchs—J Zacwilichowski The innervation of the sense organs of the wings of insects (3)

## SYDNEY

Royal Society of New South Wales, Dec 8—M B Welch, F A Coombs, and W McGlynn Notes on wattle barks (3) An investigation has been made of the tannin content of the barks of the principal species of *Acacia* belonging to the so-called 'decurrens' group Six species which can be recognised are described and a number of bark analyses are given *A mollissima* is the outstanding species with regard to tannin content, although *A decurrens* and *A Arundelliana* yield useful barks and may prove of value under conditions which are unfavourable to *A mollissima*—E Cheel and M B Welch A new species of wattle The new wattle is closely related to the 'silver wattle' (*Acacia dealbata*), but has longer leaflets and not so many pairs of pinnae, and the whole leaf has a fern-like appearance, which has prompted the colloquial name 'fern-leaf wattle' It has some resemblance to the 'tan-bark wattle' or so-called 'black wattle' (*Acacia mollissima*), but the 'fern-leaf wattle' flowers during July-August and has broad, flat pods, whereas the 'tan-bark wattle' flowers during November-December months and produces very narrow pods—M B Welch Notes on the shrinkage of wood A list is given of the lateral and volumetric shrinkages, densities, etc., measured on a number of the more important woods in use in New South Wales

## WASHINGTON, D C

National Academy of Sciences (*Proc*, vol 18, No 2, Feb 15)—Arnold Gesell The developmental morphology of infant behaviour pattern (with a demonstration of methods of systematic cinematography) Twenty-five or more children were examined at lunar month intervals, from four to fifty-six weeks of age, written and cinematograph records being taken to describe posture, locomotion, prehension, and so on An observation dome 12 ft in diameter with a special crib at the universal focal area has been built at the Yale Clinic of Child Development, the dome is encased in a white painted wire screen, and when illuminated, the observers and cameras outside the screen are effectively concealed Illustrative series from films taken are reproduced in the paper—Alan W C Menzies and D A Lacoss Allotropy of liquid benzene The data of other workers show that the rate of change with temperature of several physical properties alters abruptly at about 40° C—Wilder D Bancroft and John W Ackerman The fading of lakes and dyed fabrics An experimental investigation of the fastness of various dyes and mordants under different conditions—A Dorothy Bergner and A F Blakeslee Cytology of the *ferox-quercifolia-stramonium* triangle in *Datura* Differences of chromosome configuration have been found which are interpreted as due to segmental interchange—G W Beadle A possible influence of the spindle fibre on crossing-over in *Drosophila* Evidence is found of interference in the immediate neighbourhood of the spindle fibre—J L Walsh An expansion of meromorphic functions—A J Lotka Contribution to the mathematical

theory of capture (1) Conditions for capture Consideration of a system comprising one prey species and one predatory species—Edward V Huntington A new set of independent postulates for the algebra of logic with special reference to Whitehead and Russell's "Principia Mathematica"—D V Widder Preliminary note on the inversion of the Laplace integral—Francis D Murnaghan On the unitary invariants of a square matrix—Tracy Yerkes Thomas Conformal tensors (2)—Luther Pfahler Eisenhart Intransitive groups of motions—Solomon Lefschetz On certain properties of separable spaces—Eberhard Hopf Complete transitivity and the ergodic principle—Francis G Benedict, Edward L Fox, and V Coropatchinsky The incubating python a temperature study Sitting and broody hens were thought to have high temperatures, this has been disproved Lamarre-Picquot claimed in 1832 that the python coils about her eggs to supply heat for their incubation It has already been shown by Benedict and his collaborators that under ordinary conditions the body temperature of a snake is slightly below that of the environment Similar studies on an incubating python show that its body temperature is about 3° C above that of the environment It is suggested that the incubating python is an intermediate stage between non-incubating reptiles and birds in the scale of evolution from cold- to warm-blooded animals

## Forthcoming Events

## FRIDAY, JUNE 3

PHYSICAL SOCIETY OF LONDON AND OPTICAL SOCIETY (at Imperial College of Science and Technology), 2 30 to 5 30, and 7 to 9 30—Joint Discussion on Vision  
ROYAL SOCIETY OF ARTS (Indian Meeting), at 4 30—Dr J H Hutton Census of India, 1931 (Lecture)  
ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5 30—Annual General Meeting  
ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Prof J C McLennan Electrical Conductivity of Metals at the Lowest Temperatures

## SATURDAY, JUNE 4

ROYAL OBSERVATORY, GREENWICH, at 3 30—Annual Visitation  
INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section)—Summer Outing to Southampton

## MONDAY, JUNE 6

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4 30—Sir Ambrose Fleming Some Recent Scientific Discoveries and Theories (Presidential Annual Address)  
ROYAL INSTITUTION OF GREAT BRITAIN, at 5—General Meeting

## TUESDAY, JUNE 7

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5—Dr J W McNee The Liver and Spleen their Clinical and Pathological Associations (Croonian Lectures) (2)  
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30—Prof W J Sollas The Sagittal Section of the Human Skull Pt II Palæanthropic Skulls (Lecture)  
INSTITUTE OF BRITISH FOUNDRYMEN (Annual Conference) (at Newcastle-upon-Tyne) (continued on June 8 to 10)

## WEDNESDAY, JUNE 8

GEOLOGICAL SOCIETY OF LONDON—L R Wager Geological Work in East Greenland during the British Arctic Air-Route Expedition, 1930-31 (Lecture)  
UNIVERSITY OF OXFORD (in University Museum)—Dr R A Fisher Social Selection of Human Fertility (Herbert Spencer Lecture)

## THURSDAY, JUNE 9

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5—Dr J W McNee The Liver and Spleen their Clinical and Pathological Associations (Croonian Lectures) (3)

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 730—Annual General Meeting  
CHELSEA PHYSIC GARDEN—Dame Helen Gwynne Vaughan  
The Contribution of Plants to the Study of Heredity  
(Chadwick Lecture)

## FRIDAY, JUNE 10

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section)  
(Annual General Meeting), at 5—E Clarke Tay's  
Choroiditis

ROYAL SOCIETY OF MEDICINE (Laryngology and Otology  
Sections) (at Eye and Ear Hospital, Portsmouth)—  
Summer Meeting (*continued on June 11*)

## JUNE 16 TO 18

ANNUAL COLLOID SYMPOSIUM (at Ottawa, Canada)

## Official Publications Received

## BRITISH

Publications of the South African Institute for Medical Research No 30 Tuberculosis in South African Natives, with special reference to the Disease amongst the Mine Labourers on the Witwatersrand Pp 429+24 plates (Johannesburg)

Nyasaland Protectorate Geological Survey Department Colonial Development Water Supply Investigation Progress Report (No 1) for the Year 1931 Pp ii+27+5 plates (Zomba)

The British Mycological Society Transactions Edited by J Ramsbottom, B F Barnes and H Wormald Vol 16, Part 4, 2 May Pp 209-339 (London Cambridge University Press) 7s 6d

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1431 (A 106) Age Hardening of Aluminium Alloys By Dr Marie L V Gayler and G D Preston Pp 19+5 plates (London H M Stationery Office) 1s 3d net

The Scottish Forestry Journal being the Transactions of the Royal Scottish Forestry Society Vol 46, Part 1, March Pp ix+98+24 (Edinburgh Douglas and Poulis) 7s 6d

Proceedings of the Royal Society Series A, Vol 136, No A829, May 2 Pp 464 (London Harrison and Sons, Ltd) 23s 6d

List of the Linnean Society of London, 1931-1932 Pp 71 (London Linnean Society)

Report of the National Baby Week Council, 1931, presented and adopted at the Fifteenth Annual Meeting of the National Baby Week Council held in London on the 16th March 1932 Pp 24 (London)

The Carnegie United Kingdom Trust Eighteenth Annual Report (for the year ending December 31st, 1931) approved by the Trustees on March 11th, 1932 Pp ii+95+4 plates (Dunfermline)

Birmingham Bureau of Research on Russian Economic Conditions Memorandum No 5: Remarks on the Five Year Plan, II Agricultural Collectivization, III Oil Consumption and Export Pp 24 (Birmingham The University)

Transactions of the Optical Society Vol 33, 1931-32, No 1 Pp ii+36 (London Optical Society) 10s

University Grants Committee Returns from Universities and University Colleges in receipt of Treasury Grant, Academic Year 1930-31 Pp 28 (London H M Stationery Office) 1s 6d net

Journal of the Indian Institute of Science Vol 15B, Part 1 A New Permeameter By K V Karanthia Pp 16+14 plates (Bangalore) 18 rupees

The Half-yearly Journal of the Mysore University Vol 5, No 1, January Pp 190 (Bangalore The Bangalore Press) 2 rupees

Bulletin of the Raffles Museum No 6, December 1931 Pp 154 (Singapore Raffles Museum) 1 dollar, 2s 6d

Memoirs of the Queensland Museum Vol 10, Part 2, 30th March Pp 89-130 (Brisbane Queensland Museum)

Canada Department of Mines Geological Survey Summary Report, 1930, Part D (No 2288) Pp 143D Summary Report, 1931, Part B (No 2300) Pp 84B Memoir 149 Geology and Mineral Deposits of a part of Southwestern Manitoba By J F Wright (No 2296) Pp iii+150 25 cents (Ottawa F A Acland)

Dominion of Canada Report of the Department of Mines for the Fiscal Year ending March 31, 1931 (No 2297) Pp v+61 (Ottawa F A Acland) 25 cents

Indian Journal of Physics, Vol 6, Part 6, and Proceedings of the Indian Association for the Cultivation of Science, Vol 15, Part 6 Conducted by Sir C V Raman Pp 467-606 (Calcutta) 3 rupees, 4s

The Institution of Professional Civil Servants Annual Report of Council for the Year 1931 Pp xiii+45 (London)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1439 (T 2298) Effects of Sideslip on Rolling and Yawing Moments By F B Bradfield and A S Hartshorn Pp 4+10 plates, 6d net No 1442 (T 3171) Motions of a Stalled Bristol Fighter fitted with Auto Control Slots and Interceptors By A Ormerod Pp 4+4 plates 4d net No 1435 (A 176488) Dimensional Stability of Heat-treated Aluminium Alloys By J D Grogan and D Clayton Pp 18+13 plates 1s net (London H M Stationery Office)

Southern Rhodesia Geological Survey Bulletin No 19 Interim Report on the Geology of part of the Salisbury Gold Belt By R Tyndale-Biscoe Pp 39+4 plates (Salisbury) 2s

Journal of the Society for the Preservation of the Fauna of the Empire New Series, Part 16 Pp 64 (Hertford Stephen Austin and Sons, Ltd, 1932) 2s

The Proceedings of the Physical Society Vol 44, Part 3, No 243, May 1 Pp viii+231 43s (London Physical Society) 7s net

The Rhodesian Museum, Bulawayo Thirtieth Annual Report, 1931 Pp 15 (Bulawayo)

Northern Naturalists' Union Transactions Edited by Dr F C Garrett Vol 1, Part 1 Pp 77 (Newcastle on Tyne Andrew Reid and Co, Ltd) 4s

Proceedings of the Royal Society of Edinburgh, Session 1931-1932 Vol 52, Part 2, No 8 On the Structure of Vertebraria By Prof John Walton and Miss Jessie A R Wilson Pp 200-207+2 plates 1s 3d Vol 52, Part 2, No 9 Graphical Analysis of Internal Combustion Engine Indicator Diagrams By Alex R Horne Pp 205-217 9d Vol 52, Part 2, No 10 The Pigmentary System and the Dopa Reaction By Evelyn Boyd Pp 218-235+4 plates 2s 6d Vol 52, Part 2, No 11 The Zeta Function of Jacobi By L M Milne Thomson Pp 286-290 1s 3d (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd)

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 70, No 425, May Pp 477-588+vi (London E and F N Spon, Ltd) 10s 6d

Proceedings of the University of Durham Philosophical Society Vol 8, Part 5, 1931-1932, February Pp iii+359 467+vi (Durham) 5s

Royal Observatory, Edinburgh Forty second Annual Report of the Astronomer Royal for Scotland, 1932 Pp 7 (Edinburgh and London H M Stationery Office) 2d net

## FOREIGN

Bell Telephone System Technical Publications, Monograph B 656 Modern Developments in Precision Clocks By Alfred L Loomis and W A Harrison Pp 30 (New York Bell Telephone Laboratories)

University of Denver Department of Anthropology Archaeological Survey of Eastern Colorado, Second Report By E B Renaud Pp 45 (Denver, Colo)

Conseil Permanent International pour l'Exploration de la Mer Journal du Conseil Vol 7, No 1 Redige par E S Russell Pp 165 (Copenhagen Andr Fred Høst et fils) 4 50 kr

Conseil International de Recherches Union Geodésique et Géophysique Internationale Section de Seismologie Publications du Bureau Central Seismologique International Série A, Travaux scientifiques, Fascicule No 7 Communications présentées à la Conférence de Stockholm (Aout 1930) Pp 123+14 planches (Strasbourg)

U S Department of Agriculture Technical Bulletin No 291 The Effect of Air Drying on the Hydrogen Ion Concentration of the Soils of the United States and Canada By Ernest H Bailey Pp 44 (Washington, D C Government Printing Office) 10 cents

Smithsonian Institution Explorations and Field Work of the Smithsonian Institution in 1931 (Publication 3134) Pp iv+190 (Washington, D C Smithsonian Institution)

Library of Congress A List of American Doctoral Dissertations printed in 1930 Prepared by Mary Wilson MacNair Pp vi+342 (Washington, D C Government Printing Office)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan Second Series (Geology), Vol 15, No 2 Pp 41-168+plates 5 10 (Tokyo and Sendai Maruzen Co, Ltd)

Journal of Science of the Hiroshima University Series A (Mathematics, Physics, Chemistry) Vol 2, No 2 Pp 103-158 72 sen Series B, Div 1 (Zoology) Vol 1, Articles 5-9 Pp 65-168 185 yen Series B, Div 2 (Botany) Vol 1, Article 4 Studies on the Hepaticae of Japan, V By Yoshiwo Horikawa Pp 55-76+plates 7 9 41 sen Vol 1, Articles 5-9 Pp 77-134+plates 10 10 106 yen (Hiroshima)

Collection des travaux chimiques de Tchecoslovaquie Rédigée et publiée par E Votocék et J Heyrovský Année 4, No 4, Avril Pp 145-192 (Prague Regia Societas Scientiarum Bohemica)

Proceedings of the Imperial Academy Vol 8, No 3, March Pp v+1+59 112 (Tokyo)

Acta Photochimica Edited by Prof Keita Shibata Vol 6, No 1, April Pp 178 (Tokyo Iwata Institute of Plant Biochemistry) 3 50 yen, 1 70 dollars

U S Department of Commerce Coast and Geodetic Survey Serial 540 Magnetic Declination in the United States, 1930 By Daniel L Hazard Pp 41 (Washington, D C Government Printing Office) 10 cents

Proceedings of the United States National Museum Vol 80, Art 15 The Copepod Crustaceans of Chesapeake Bay By Charles Branch Wilson (No 2915) Pp 54+5 plates (Washington, D C Government Printing Office)

Proceedings of the American Philosophical Society Vol 71, No 2 Pp 39-71 (Philadelphia)

Annales de l'Observatoire de Paris, Section d'Astrophysique, a Meudon Publiées par Ernest Esclapart Tome 6 Cartes synoptiques de la chromosphère solaire et catalogue des filaments de la couche supérieure Par L d'Azambuja Fascicule 5 Années 1925, 1926, 1927 Pp 88 (Meudon)

Japanese Journal of Mathematics Transactions and Abstracts, Vol 8 (1931) (conc uded) Pp 297-326+27 (Tokyo National Research Council of Japan)

Koninklyk Nederlandsch Meteorologische Instituut No 106a Ergebnisse aerologische Beobachtungen, 19, 1930 Pp iv+44 2 50 f No 108 Seismische Registrierungen in De Bilt, 17, 1929 Pp iv+71 1 20 f No 110 Oceanographische en meteorologische Waarnemingen in den Atlantischen Oceaan, September, October, November (1870-1925) Kaarten Pp ii+34 7 50 f (Amsterdam Seyffardt's Boekhandel)

Unione Astronomica Internazionale Immagini spettroscopiche del bordo solare osservate a Catania, Madrid e Zurigo negli anni 1927 e 1928 Pubblicata per Cura del R Osservatorio Astrofisico di Arcetri Pp 12+21 tavole (Firenze R Osservatorio Astrofisico di Arcetri)

Pubblicazioni della R Università degli Studi di Firenze Fascicolo N 48 Osservazioni e memorie del R Osservatorio Astrofisico di Arcetri Pp 63 Fascicolo N 49 Osservazioni e memorie del R Osservatorio Astrofisico di Arcetri Pp 69 (Firenze)

Zentralanstalt für Meteorologie und Geodynamik Publikation Nr 137 Beihefte zu den Jahrbüchern der Zentralanstalt für Meteorologie und Geodynamik Erstes Heft der Reihe, Beihefte zu Jahrgang 1928 der Jahrbücher Pp ii+117 (Wien Gerold und Ko)

U S Department of Commerce Bureau of Standards Bureau of Standards Journal of Research Vol 8, No 4, April, Research Papers Nos 427-433 Pp 445-547 (Washington, D C Government Printing Office) 40 cents



SATURDAY, JUNE 11, 1932

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No 3267, VOL 129]

## The Colonial Forests and their Staffs

AS will be remembered, one of the problems considered by the first Empire Conference of Prime Ministers which met in London was the question of forestry in the Empire and the method by which a common and consistent forest policy should be formulated and adhered to afterwards by the individual parts. Empire settlement in connexion with forestry was one of the aspects to which attention was given. These matters were fully considered by a Forestry Subcommittee which was set up.

One of the dangers inherent in a problem of this type is the almost inevitable prominence given to the utilisation side of the question, obviously the best understood, and, it may be added, the best propaganda, when forests and forestry are in question. An examination of the memoranda and reports published displays the rather overwhelming preponderance given to the question of the world's timber supplies and the possibility of the Empire (a) becoming more or less self-sufficient in timber supplies, (b) developing larger export markets of her tropical timbers. It was recognised that there existed social and economic problems which necessitated each country in the world formulating a policy which should maintain a sufficient area of forest under a conservative management, and this recognition has been growing in force amongst those administrators and specialists who have given attention to this matter in the British Empire. Important, however, as the question of the world's existing resources in timber undoubtedly is, the accompanying and correlated one—the protection from needless destruction of the world's remaining forests, especially in the tropical and subtropical regions, and their proper management—is equally imperative. On three separate occasions this matter has been brought up at meetings of the British Association—in 1850, 1920, and 1926, whilst serious consideration was given to it by foresters interested in tropical forestry at the World's Forestry Conference in Rome in May 1926 (*vide* NATURE, Jan 8, 1927).

As an outcome of the Oxford meeting of the British Association in 1926, Lord Clinton, chairman of the Forestry Subsection, drew up for the Council a short memorandum discussing the destruction of forests on hill slopes, with the well-known after-results, with especial reference to the tropical forests of the Empire. There was nothing new in this memorandum. The subject had been brought up before. But in the hands of so able

a man as the chairman of the Forestry Commission it was believed that the question would receive a sympathetic consideration. The Clinton memorandum was submitted to the Secretary of State for the Colonies, by whom it was communicated to the governors of the various protectorates and colonies.

There was apparently no longer any doubt in the minds of the responsible authorities at the Colonial Office, as there could not have been in those of the Subcommittee of the Empire Conference, that certain practices to which a considerable proportion of the tropical forests of the Empire were still exposed should be stopped, or, at the least, efficiently regulated. The best known of these, by which annually the forests so treated are losing their value or being threatened with total annihilation, are shifting cultivation, excessive grazing of domestic stock, and the annual firing of the forest lands.

As, after the War, the Colonial Office had commenced to recruit trained men for all the various local forest services in the dependencies under that Office, there did not appear to be any reason why the action taken in 1926-27 should not at length meet with a decided and firm response from the several local administrations responsible for these valuable, and in many cases as yet commercially untapped, tropical forests. It may be stated at once that genuine attempts were made towards taking steps to give effect to the Secretary of State's wishes in this matter. Moreover, there were one or two young services which had been inaugurated since the War in which there was no lack of eagerness to commence the steps necessary to grapple with the unchecked and improvident habits of the local populations.

It would be impossible to discuss here the differences which obtain in the ownership, methods of local utilisation, and so forth, of these tropical forests. These vary with colony and dependency. But there is no, or little, variation in the results of the increasingly rapid destruction and deterioration of the forests exposed to the practices above-mentioned. As was seen in India, where formerly a similar state of affairs existed, no forest service in the world can attempt successfully to introduce measures for the regulation, control, and eventual suppression of these injurious acts unless it is strongly supported by the civil authority and, nowadays, by the governor's legislative council, which body will include a number of non-official members.

There can be little doubt that the result of the

active and far-sighted policy of the Colonial Office during the last decade has brought the forests of the protectorates and colonies into a prominent position, and that there now exists throughout the country some knowledge of their importance, and also of possible careers for active young men who make themselves efficient by a university training. To this point it may be said, therefore, that recognition has been given to the need for the conservation and effective management of the Empire tropical forests. But has effective action, necessary in every colony, been taken? Has a forest staff of sufficient strength been recruited? Mere lip service to a recognition of the perils to which a colony will be exposed by the further unchecked destruction of its tropical forest areas, or important sections of them, will not stop the sacrifice, and, each year it is allowed to continue, the destruction, with erosion, etc., proceeds at a greater rate.

Owing to the world-wide financial stringency, government staffs, as also commercial staffs, are so far as possible being reduced and recruitment has been kept at the lowest possible minimum. In the case of the colonial services, the forests have been treated on the same basis as other departments. It may be asked, is this policy, even though the forest department budgets are showing a temporary deficit (for adverse trade immediately reacts on forest receipts), correct or even sound, in the case of a colony possessing capital in the form of undeveloped forest areas subject to abuses and deterioration? Even while admitting that every sound effort should be made towards retrenchment, if the wishes and sentiments expressed by the Empire Conference and ministers on the matter of stopping the long-continued destructive practices of the populations living in, or in the vicinity of, tropical forests were anything more than a pious expression of opinion between 1924 and 1927, how has the position changed? It would appear to be even more vital—the more so since a perusal of the annual reports of the heads of the various forest departments in the colonies and dependencies for the past six years or so will disclose an almost unanimous complaint about the paucity of the staff and the necessity of strengthening it if real conservation was to be introduced, though in a few cases there has been a considerable expansion. In how many of these colonies is the practice of shifting cultivation as rife as it was twenty years ago?

These queries are not put with any idea of a criticism of the Colonial Office authorities. Far



otherwise, as will appear. In a recent article on "Forests and the Economic Crisis" in the *Empire Forestry Journal* (vol 10, No 2, 1931), Sir Roy Robinson deals with what he aptly expresses as the blizzard blowing over forestry. Sir Roy asks what foresters can do, and enumerates five points, covering inaction or action. In one of these he says "If Forestry has proved an easy subject for drastic cuts it is because it had not made sufficient friends. In other words, our educational effort has not yet borne the desired fruits." It would appear that Sir Roy is regarding the matter chiefly from the point of view of forestry in Britain, where, apart from administrators and politicians, an educated forestry opinion in the public would be a strong asset. The position is, however, very different in the case of colonial countries, where an educated public opinion is non-existent, and where the point of view of the administration is the only one to be taken into account. Moreover, Great Britain does not possess any capital in the shape of large areas of undeveloped forests, which is commonly the case in the colonies.

This being so, the fact remains that in spite of the full recognition given to the importance of putting a stop to the destruction of tropical forest, a step which is only possible by having a strong forest department in the colony and backing it up with full official authority, forest staffs are actually being reduced, in a most drastic fashion, and recruitment stopped. In other words, in the interest of a perfectly understood and implicitly believed-in campaign of retrenchment, the development of the capital resources of a colony are being put back by a decade, whilst parts of the capital are subject to annual depreciation. Several instances could be quoted. The case of British Honduras presents some exceptional features and may be regarded as an extreme case, but it has the merit of exhibiting the problem in a manner calling for no expert knowledge upon which to base an opinion.

It is common knowledge that mahogany has been exported from British Honduras for several centuries. Not before 1922 was a small forest department inaugurated. Four years later this young department had six trained officers, the administration being placed under a Forest Trust. The forests were chiefly worked by lumbering companies on leases from government. The young department worked in well with the old methods and had begun to make a most promising headway. The *dénouement* exemplifies the purpose of this article and the question implied

Should a financial deficit in a colony possessing considerable areas of undeveloped valuable tropical forest, at present subject to annual and increasing destruction, justify the abrupt stopping or serious checking of the work in hand or urgently needing being taken up? The following shows what has happened in British Honduras.

Owing to a falling off in forest revenue, the Unofficial Members of the Legislative Council signed a petition on Jan 22, 1929, praying for a general curtailment of the forestry programme and reduction of Forest Trust expenditure. This petition, with comments by the Governor and his advisers,<sup>1</sup> was submitted to the Secretary of State for the Colonies, Lord Passfield. The reply was as follows, and is very instructive.<sup>2</sup>

"In another connection the attention of the Secretary of State had been brought to the disquieting probability that the revenue derived directly and indirectly from forest products will suffer very serious depletion at no distant date. For this reason, in addition to those adduced by the memorialists, he is convinced that the present structure of the Forest Department is heavier than the Colony's economic framework can sustain.

"At the same time, his Lordship is unalterably opposed to any amendment of the legislation governing the constitution, finance, and duties of the Forest Trust. British Honduras has depended upon its forest resources for 300 years, the approaching crisis in output will prove, it is earnestly to be hoped, of temporary duration, and the justification for providing machinery to regulate scientifically, so far as may be, the natural wealth of the Colony is as self-evident now as it was when his predecessor directed the creation of the Trust. His Lordship has accordingly reached the conclusion that the solution of the present financial difficulty is to be sought, not by altering the status of the Trust, but by curtailing its activities and consequent expenditure to the minimum consistent with the discharge of its routine duties, the preservation of its records, and the maintenance of the valuable experimental work already in hand. The adoption of this policy will ensure that when conditions justify the re-enlargement of the scope of the Trust, the nucleus of personnel and the knowledge and experience accumulated will be ready to hand. His Lordship ventures to express the hope that the Unofficial Members of the Legislative Council will exercise the foresight which their position as guardians of the Colony's destinies demands and will lend their willing support in the policy here outlined."

These orders involved a cutting down of the staff, several officers being transferred elsewhere, the loss of the experimental silvicultural work of great promise which had been commenced, for such work is doomed without the eye of the trained officer upon it, and the postponement of the

opening out of considerable areas of unknown forests in this Colony

Lord Passfield may be congratulated on his firm attitude. Nevertheless, until it is recognised that a temporary fall in revenue in the case of inadequately staffed forestry departments should not be met by cutting down expenditure, staff, and so forth, no efficient or rapid progress can be made in the development of potentially rich but imperfectly known forest areas, whilst the delay in introducing an efficient check on indiscriminate acts of destruction is yearly reducing the value of this often irreplaceable asset.

This view of the matter finds strong support in a question connected with Empire timber supplies. In the annual report of the Forest Products Research Board of the Department of Scientific and Industrial Research, the increased interest of the public in Empire timbers is commented upon. The writers, however, stress the opinion that the joint work of the Department and the Empire Marketing Board was not in itself sufficient to cover the necessities of achieving a general development and national use of Empire timbers. Unless production and marketing are closely co-ordinated with research, the work of the Board will be impaired. Amongst other suggestions, the one "that some enlargement of the facilities at the disposal of the Forest Services" is timely. It appears obvious that if production, marketing, and research are to be efficiently co-ordinated, the first step is to go to the fountain-head and maintain or appoint a forest staff of sufficient strength to manage effectively the tropical forest areas in the several colonies.

<sup>1</sup> British Honduras, Report of the Forest Trust, 1930. Belize, 1931.  
<sup>2</sup> Reply to Petition by the Acting Colonial Secretary, dated Belize, Oct 9, 1929.

### Anthropology in Indian Administration

*The Lakhers*. By N E Parry. With an Introduction and Supplementary Notes by Dr J H Hutton. Published by direction of the Government of Assam. Pp xx+640+17 plates. (London: Macmillan and Co., Ltd., 1932.) 36s. net.

MR PARRY'S volume on the Lakhers, for more reasons than one, is a notable addition to the valuable series of monographs on the Naga and other tribes of Assam, published under the direction of the Government of that Province. Apart from its intrinsic merits as a further record of ethnographic facts, owing to the circumstances in which it came to be written, it affords an illustration of the kind of material—the information re-

lating to native life and institutions, the language, customs, and beliefs—which should be mastered as a background for the work of administration. The book, as Mr Parry explains, grew out of a series of brief notes collected with the object of recording those customs concerning which litigation most often arises among the people. The author speedily found, however, that custom was inextricably interwoven with the whole life of the people, and that anything short of a fairly complete knowledge of their daily life would give neither their point of view nor any idea of the practical effect of custom.

A further point in which Mr Parry's book is exceptionally valuable is that it records the life of a people whose institutions have undergone little, if any, serious modification as yet through European administration. It was in 1924 only that the last of the Lakher villages were brought under British control. It is probable that the Lakhers may not have occupied their present situation in the south-east corner of the Lushai Hills for any great length of time. Judging from the number of abandoned village sites, it is estimated that their settlement must have taken place between two and three hundred years ago. Be that as it may, their first contact with the British appears to have been in the forties of the last century, when, as a part of the tribes then known collectively as the Shendus, they were regarded as a powerful and warlike nation—a reputation which appears to have rested to a great extent on lack of knowledge and the difficulty of getting into touch with them, rather than on any very great achievement in their numerous raids. Lakher villages first came under British rule when the Lushai Hills district was formed in 1889. A period of raiding and punitive expeditions followed, culminating in great tribal unrest after the War, which was brought to a close in 1924 with the annexation of the hitherto independent villages lying between Assam and Burma.

Peoples relatively primitive and absolutely untouched by European civilisation, who may be studied in conditions such as have favoured Mr Parry, are becoming increasingly rare day by day. Anthropologists will be duly grateful to the author for seizing the opportunity of making this record of Lakher culture before any fundamental change had taken place. On the other hand, in modern conditions change is rapid, and while the static point of view may well prevail in certain departments of academic study, when it is desirable to apply the results of anthropological science

to a practical problem, as in administration, the dynamic point of view is essential. The questions which then become vital are the quality, degree, and direction of change which are likely to arise as a consequence of contact with European culture, and, of still greater moment, the repercussion of any modification of native custom which may have been introduced by administrative action.

On both these points Mr. Parry has information to record, which is all the more valuable because, administrative action having been confined to a minimum, the changes are few and readily isolated for purposes of study. The Lakhers themselves, though regretting their former freedom of action, admit that British rule has brought advantages in its train, especially in their freedom from ambush and raid, particularly during their beer parties. Now, as they say, they are no longer in danger of "being cut up while they are intoxicated." Although, on the whole, Lakher custom has been scrupulously respected, naturally an end has been put to the taking of human heads, which was customary on the death of a chief to terminate the mourning of his family and village. The mourning custom remains unchanged, but the head of a tiger, wild boar, or wild *mithun* (*Bibos gaurus* or *frontalis*) is now substituted.

In another direction also change has followed administrative action. The position and the importance of the chiefs have been affected by the liberation of the chief's slaves, or dependents, as Mr. Parry prefers to call them. Again, there is a tendency for the villages to become smaller. New settlements are founded by fission from the older with greater frequency than they were formerly, no doubt a result of the sense of greater security now enjoyed. It is probable, however, that in the long run the most lasting effect will follow from the new-found familiarity with and possession of money. This has accrued from the outlet now available for the disposal of the surplus production of rice in the recently annexed villages, where the inhabitants are more industrious and energetic than those of the villages which have been under British administration for some time.

At the risk of laying undue stress upon what is after all only one aspect of Mr. Parry's work, though undoubtedly of great importance, the question of cultural change may be carried a step further. Recent discussion of the place of anthropology in practical affairs has shown a tendency to disparage the claims of comparative study in favour of intensive observation of specific peoples.

While this is not the occasion to attempt a precise definition of the scope and function of the comparative method in such matters, it may be pointed out that a too exclusive attention to a culture as it exists and functions at the moment, without regard to its historic and developmental background, may lead to the neglect of inferences of moment in the study of the effect of cultural impact and the consequent modification, whether favourable or the reverse, in racial character, culture, and social organisation. Indeed it would seem at times, in such discussions as those to which we refer, as though it had almost been forgotten that European civilisation is by no means the only outside influence to which most of the less advanced peoples have been subjected. It is only by the employment of historical and comparative methods that the fact of such contacts, their succession and their results, often far-reaching, can be established.

This important aspect of Lakher culture is discussed in the valuable introduction contributed by Dr. J. H. Hutton, to whose knowledge and counsel the authors who have contributed to this series are so deeply indebted. He points out how the culture of the Lakhers serves to throw light on the stratification of culture of the Assam-Burma Hills. The Assam Hills are, as a matter of fact, in a sense, a key position in the study of cultural distribution in the south-east of Asia and the regions beyond. The Lakhers, it would seem certain, came from various points in the Chin Hills, presumably being pressed forward from the east as were the Lusheis. While some of their customs are typically Naga, and some typically Kuki, others appear to belong to neither of these cultures. Externally they appear to be definitely a Kuki tribe, their language and material culture associating them with the Chins. One interesting example of their affinity with the Kukis may be mentioned. In the legend of the theft of fire by a fly, among the Nagas the object stolen was the fire stick, but among the Lakhers, as among the Kukis, the secret was the flint and steel. The distribution of the institution of a separate house for the young men is also of no little significance. It occurs among the Nagas, but not among the Sema Nagas, although there appears to be a tradition of it. It does not occur among the Kukis, who may be responsible for its absence among the Sema, and the Lakhers follow the Kukis. With both of them, each of the young men takes up his lodging for the night in the house of any young girl to whom he may take a fancy. Yet in his attachment to his village site and to the

graves of his ancestors, Dr Hutton points out, the Lakher is essentially a Naga

In conclusion, it is perhaps permissible to recall that Assam has been singled out of late for favourable comment in the Press for its attitude in recent and still continuing troubled times. Might not the credit, at least in part, have been given to a Government which appreciates, and encourages its officers to adopt, a scientific approach to the problems of administration among a non-European people?

### The Differential Equations of Physics

*Partial Differential Equations of Mathematical Physics* By Prof H Bateman Pp xxii+522 (Cambridge At the University Press, 1932) 42s net

THE main work of mathematical physicists is to represent the sequence of phenomena in time and space by means of differential equations, and to solve these equations. Even the revolution effected by relativity and quantum theory has not changed this fundamental fact. A few years ago, indeed, when the discrete nature of quantum phenomena was being emphasised, it seemed as if differential equations might be replaced in ultimate physics by difference equations. But the discovery of wave mechanics restored the *status quo ante*, and to-day differential equations are more important than ever before.

The differential equations of physics form a class by themselves, though it is not easy to characterise them by a formal definition. In a general way, we may say that physical laws are of the nature of minimum principles (for example, a chain suspended from two points assumes that form which makes the height of its centre of gravity a minimum, a ray of light passing through any number of lenses takes that path which makes the time of passage a minimum, two substances which can change physically or chemically into each other, when placed in contact at a given pressure and temperature, take up that state which makes the thermodynamic potential a minimum, and so on). Therefore the differential equations of physics are essentially the differential equations which solve minimum problems, that is, they are the differential equations which arise in the calculus of variations. With this definition, however, some of the familiar equations, such as the equation of conduction of heat, can only be brought in awkwardly as limiting cases, and perhaps it is best to abandon the search for a definition, and simply to take as

subject matter the equations which have actually been encountered in physical investigations, trusting to exhibit the essential unity of their theory in the course of developing it.

In most cases the problem is to determine a function of the time and the co-ordinates, which in a given domain satisfies some linear partial differential equation of the second order, and also satisfies certain conditions at the boundary of the domain and certain initial conditions corresponding to a given value of the time. The first problem is to find the nature of the initial and boundary conditions which are necessary to determine a solution uniquely. Here the most surprising facts confront the beginner: thus in the case of the equation

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0,$$

a solution is uniquely determined at points in the interior of a closed curve in the  $xy$ -plane when the value of  $u$  is given at all points of the curve, whereas in the case of the equation

$$\frac{\partial^2 u}{\partial x^2} - \frac{\partial^2 u}{\partial y^2} = 0,$$

which differs from the former only by a change of sign, a solution is uniquely determined when the values of *both*  $u$  and  $\frac{\partial u}{\partial y}$  are given along an *open* curve. The complete resolution of these apparent contradictions by means of the theory of characteristics is one of the most entrancing chapters in mathematics, and as the student proceeds to learn about autovalues (or proper values, or characteristic values, or eigen values, as you please) and autofunctions, about Green's functions and Riemann-Green functions, about the Kirchhoff-Huygens theory of solution by integrals, and the many other properties that are common to large classes of these differential equations, he realises that he is dealing not with a loose collection of examples but with a coherent and unified doctrine which is as fascinating to the pure mathematician as it is important to the physicist.

The need for a substantial modern treatise on this subject has long been recognised, but prospective authors have been deterred by the appalling list of qualifications which the writer of such a book should possess. The first treatise on these equations, written more than a century ago—Fourier's "*Théorie analytique de la chaleur*"—contained more than five hundred quarto pages; since then, more than a hundred thousand pages of memoirs on them must have appeared. An author to-day should know thoroughly the older

mathematical physics—hydrodynamics, elasticity, sound, conduction of heat, thermodynamics, physical optics, electromagnetic theory—and also the newer branches—aerodynamics, general relativity, wave mechanics. Moreover, he must be a first-class pure mathematician, capable of distilling the essence from the gross matter and presenting in a book of reasonable size an orderly account of the ideas and principles and methods by which mathematical physics has been advanced.

The announcement made a year or so ago, that Prof. Harry Bateman—Senior Wrangler in 1903, fellow of Trinity College, Cambridge, and now professor of mathematics at the California Institute of Technology—had undertaken this task, was therefore received with a lively hope and interest. For Prof. Bateman is one of the most eminent living scholars in this domain. The work, which is now published, is one of the gigantic blue-bound tomes to which the Cambridge Press has accustomed us. xxii + 522 pages, and highly condensed at that. An examination in detail fills one with admiration for the author's skill and learning. He seems not only to have read everything, but also to be capable of proving any theorem more neatly than its original discoverer. The analytical dexterity which was fostered by the old Cambridge tripos was never more brilliantly displayed.

Unfortunately, there is another side to the picture. It is not possible to mention the great merits of the book without admitting that it has one serious defect. This is, the lack of what one may call architectural structure. I mean, of design, selection, and arrangement. The author seems to pour out his treasures pretty much as they come into his mind, and presents his results without clearly disentangling the essential points on which attention should be focused, and without ordering the whole on any recognisable plan. The trouble is, I think, partly due to the fact that he does not seem to have quite made up his mind what class of readers he is writing for, but ranges over the whole breadth of his own erudition. At one time we hear about Lebesgue integrals, at another technological details about the moisture in the heartwood of a piece of Sitka spruce. In one place he proves the ordinary Lagrange's equations of motion in dynamics. But is it likely that anyone who was not already acquainted with Lagrange's equations would tackle a 500-page book on the partial differential equations of mathematical physics?

The early chapters are the least satisfactory, because it is there that we notice most the failure

to set leading principles in a high light. When the author gets to the middle of the book, and displays his analytical skill successively with polar co-ordinates, cylindrical co-ordinates, ellipsoidal co-ordinates, paraboloidal co-ordinates, and toroidal co-ordinates, we feel that we are reading the work of a master.

One wishes the author had treated some things more fully, for example, the theory of characteristics (on which §§ 1.92 and 2.24 are scarcely adequate), or the general theory of conservation laws (on which he gives only some results set as examples on p. 183), or the interesting differential equations which occur in general relativity (particularly in connexion with the electromagnetic field), or the differential equations of wave mechanics. But one feels that criticism is ungracious for the book is indeed unique, an invaluable work of reference, a thesaurus which no college or university library, and no working mathematical physicist, can afford to be without.

I have noticed only one error, namely, on p. 181, where the introduction of electromagnetic momentum is attributed to Abraham and Poincaré (whose papers appeared in 1900–2). The credit for this important discovery properly belongs to J. J. Thomson, who published it in 1893 in his "Recent Researches in Electricity and Magnetism".

E. T. WHITTAKER

### Chemical Elements at a Glance

*Chemischer Handatlas. Anorganische Chemie unter besonderer Berücksichtigung von Atomphysik und Atomchemie. Graphische Darstellung der Eigenschaften chemischer Elemente und ihrer Verbindungen nach der Anordnung des natürlichen Systems der Elemente auf 60 vielfarbigten Karten mit Beschriftung in deutscher, englischer, französischer, italienischer, spanischer Sprache nebst ausführlichem, erläuterndem Texte.* Von W. Walter Meissner. Pp. xi + 77 + 60. (Braunschweig, Berlin und Hamburg: Georg Westermann, 1931.) 38 gold marks.

THE modern developments of the theory of atomic structure are intimately connected with the periodic system of the elements, and it has become increasingly necessary and important to have available some scheme in which the various properties of the elements can be exhibited as a connected whole, so that comparison between values for the elements can be made. This suggests that the properties concerned should be represented by some kind of symbols, the size of which should

convey an idea of the magnitudes. The "Atlas der physikalischen und anorganischen Chemie" of A. von Antropoff and M. von Stackelberg, published in 1929, carried out the scheme in a number of loose sheets, printed in black, and accompanied by a separate volume of text. The atlas of Meissner, which is more convenient in size, and is bound together as text and plates in one book, carries the systematisation a step further, since colours are employed, and, in addition to lines of varying lengths, there are figures of various shapes denoting special properties.

Although at first sight the result may seem a little complicated, a few minutes spent over the book will enable the reader to grasp the general plan and to understand without difficulty the symbolism used. The text is in German, the other languages being used only for the headings of the charts. A great amount of information is compressed into the text, and, what is more, references to the original literature are included. The main interest is in the direction of atomic structure, but the charts cover a wide field, including such matters as geographical distribution, a history of the chemical elements (a valuable and unusual feature), solubilities, and even analytical separations. It is clear that the amount of information contained in the atlas is really very considerable, and the book may be warmly recommended as likely to be most useful not only to chemists but also to workers in other sciences who wish to obtain an impression of modern chemical science, and to follow this up by reference to the original literature.

Among such a mass of detail errors are unavoidable, and it is to be hoped that in the preparation of future editions a close revision of the whole will be carried out, since the value of such a compilation is seriously affected if it is not absolutely accurate. In Table 48, for example, two values (143.1 and 143.9) are given for the heat of formation of magnesium oxide, and the formula of fluorine oxide is printed incorrectly. The scale of solubilities in Charts 52-57 is only half the correct size (as is pointed out in the list of errata on p. 77), and this should be put right in future editions. There are other similar errors, and the book would be improved by a careful overhaul. The text is also, for English readers, likely to prove rather difficult by reason of the unusually long and involved sentences and long words. This is no doubt a consequence of the necessity for condensation in the text, which has enabled a large amount of information to be given opposite each plate.

This atlas will prove of great use to teachers and

lecturers, since it provides much material in a brief form suitable for incorporation into lecture courses. The charts are well conceived and, on the whole, well executed, and the advantage of having the text bound together with the charts and facing them is obvious. The price is rather high.

### Short Reviews

*Gmelins Handbuch der anorganischen Chemie*  
Achte vollig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System-Nummer 8. Jod. Lieferung 1. Pp. 244. 37 gold marks. System-Nummer 45. Germanium. Pp. xviii + iii + 62. 13 gold marks. System-Nummer 59. Eisen. Teil B, Lieferung 4. Pp. 657-872. 28 gold marks. (Berlin: Verlag Chemie G. m. b. H., 1931.)

THE first part of the volume on iodine deals with the element itself, consideration of its compounds being reserved for the second part. The authors claim, in an introductory note, to have produced not only a comprehensive survey but also a critical monograph on the subject. Elaborate details of the occurrence of iodine are given, not only in various minerals, fossils, and natural waters, but also in a multitude of different species of plant and animal life. The iodine content is in many cases exceedingly small, so that in cases where the milligram is too large a unit for convenience, the symbol  $\gamma$  is used to denote one-thousandth of this amount. The physical and chemical properties of the element are carefully surveyed and a lengthy section deals with the action of various solvents upon it. An interesting special feature of this volume is the commercial section, which is illustrated with graphs showing the annual output of iodine in Chile since 1868 and in Java since 1892. The world production in 1929 is given as 1650 tons, of which only about thirty tons were produced in Great Britain.

The literature on germanium has been reviewed up to May 1931, but the work of Muller, Pike, and Graham in 1926 on the preparation of the pure metal, its melting point *in vacuo*, and its volatility in various gases, has been overlooked. The volume opens with an account of Mendeléeff's prediction of the existence of eka-silicon, the discovery in 1885 by Weisbach of the mineral argyrodite, the analysis of the latter by Winkler, and the ultimate recognition of the new element which it contained. The relationship of germanium to carbon and to silicon is clearly brought out in the volume, and a list of organo-germanium derivatives is tabulated.

The fourth section of part B of the volume on iron completes the survey of that element and deals chiefly with ferrous and ferric ferrocyanides, ferrous and ferric ferricyanides, other complex cyanides, and sulphocyanides of iron. Then follows an account of the compounds of iron which contain silicon, phosphorus, arsenic, antimony, and bismuth. The volume concludes with a lengthy section upon the general reactions of ferrous and ferric compounds which can be used in analytical work.



*Die elliptischen Funktionen von Jacobi. Fünfstellige Tafeln, mit Differenzen, von  $sn\ u$ ,  $cn\ u$ ,  $dn\ u$  mit den natürlichen Zahlen als Argument, nach Werten von  $m$  ( $=k^2$ ) rangiert, nebst Formeln und Kurven.* Von Prof L M Milne-Thomson. Pp xiv + 69 (Berlin Julius Springer, 1931) 10 50 gold marks

THE scope of this work is explained by its title. The author has succeeded in condensing into a very small space three quite adequate tables of double entry, which should be very useful to all who need numerical values of elliptic functions. Entries to five places of decimals are sufficient for nearly all practical purposes, and, by restricting the entries in this manner, the author has made it possible to interpolate not only (vertically) for  $u$ , but also (horizontally) for  $m$ , the vertical interpolations are facilitated by the insertion of a table of first differences.

The tables are beautifully printed, the only defect in them which has been noticed is a dropped digit on p 14. An introduction of eight pages gives a compact set of integrals and other formulae, which add to the value of the book. Tables of elliptic functions, being essentially tables of double entry, are extremely scanty in number, the only existing tables with which these can reasonably be compared are Glaisher's much more elaborate tables of the theta functions, which are, as yet, unpublished. The publication of Glaisher's tables will not, however, make Milne-Thomson's tables superfluous, since elliptic functions can be obtained from Glaisher's tables only as the quotient of two entries.

We welcome with enthusiasm the volume under review. Before its appearance, on the occasions (not, it is true, very numerous) on which numerical values of elliptic functions were needed, the reviewer's usual procedure was to take the Smithsonian Tables and to waste perhaps half an hour in trying to unravel the mysteries of their notations, then to put them aside in exasperation and to compute the values required by means of  $q$ -series. The present work will not be the cause of similar trials of patience.

G N W

*Anatomy in the Living Model: a Handbook for the Study of the Surface Movements and Mechanics of the Human Body and for the Surface Projection of the Viscera, etc.* By Prof David Waterston. Pp xvii + 255 + 16 plates (London Hodder and Stoughton, Ltd, 1931) 25s net

WE welcome the appearance of Prof Waterston's useful manual of surface anatomy, which is illustrated with numerous figures in monochrome and colour by that excellent draughtsman the late Mr J T Murray, whose death just after the completion of the beautiful drawings in this book is a serious loss to anatomy. The book gives a careful account not only of the modelling of the body and the relations of the surface markings to the deep structures, but also to the texture of the skin and what can be learned in the living from its reactions to stimuli.

It is unfortunate, however, that a book dealing primarily with the living subject should omit any

adequate reference to the chief means now at the service of the anatomist for studying the living—namely, X-ray photography. The author of the present book admits this omission, but excuses it by the surprising statement that "X-ray examination covers too wide a field and is too specialised a matter to be included here." But the information obtained by the use of X-ray photography cannot be regarded as "too wide" or "too specialised" to be expressed in the drawings. Although the work is dealing with the *living* body, the most beautiful of Mr Murray's drawings (Plates XI to XIV and Figs 70 to 74) obviously represent in the *dead* body conditions which profoundly differ from those which obtain in the living.

*Recent Advances in Organic Chemistry.* By Prof Alfred W Stewart. Sixth edition. Vol 1 Pp xii + 429. Vol 2 Pp xii + 432 (London, New York and Toronto Longmans, Green and Co., Ltd, 1931) 21s net each vol.

AS compared with the fifth edition (see NATURE, Dec 24, 1927, p 908), the new volumes have been augmented by 42 pages and 50 pages respectively, and two plates illustrating space-models of hexamethylene and reduced naphthalene rings have been inserted. The general plan of the work remains unaltered. New matter, illustrating important researches of the last few years, has been incorporated: thus, vol 1 contains a chapter on the polymethylenes and some large carbon rings, in which noteworthy work by Ruzicka and his collaborators is discussed, and vol 2 includes an account of di- and tri-terpenes (the camphorenes and squalenes), the decalins and other fused ring-systems, and the diphenyl problem. The new edition will continue to lighten the labours of advanced students and research workers who are interested in the fields which Prof Stewart has selected for treatment in this valuable publication. For the work to remain true to its title, however, we suggest that some of the older and more familiar material ought to be replaced by sections on cholesterol, vitamins, and other subjects of current importance, the account of electronics in organic chemistry also calls for expansion. J R

*Outline of Comparative Embryology.* By Prof Aute Richards. Pp xvi + 444 (New York: John Wiley and Sons, Inc., London Chapman and Hall, Ltd, 1931) 30s net

THE first part of this book deals with those embryological processes which are common to most of the higher animal forms, and presents in assimilable form the accepted views on cleavage, germ layer formation, the egg, and embryonic membranes, including the placenta. The consideration of various invertebrate forms is based largely on the work of Korschelt and Heider. The second part of the book deals with modern problems in embryology, and presents the modern aspects of asexual reproduction, parthenogenesis, and polyembryony with clarity. The historical aspect is well maintained, and the recent expansion of experimental embryology is admirably incorporated.

## Canadian Water Power Development in 1931

By Dr BRYSSON CUNNINGHAM

THE development of hydro-electric power in Canada continues to make progress at a striking rate, the figures published in the latest returns of the Dominion Government<sup>1</sup> showing an increment of more than half a million installed horse power for the year 1931, as compared with rather less than 400,000 horse power for the preceding year. Looking back over a period of twenty years, it can be seen that the aggregate increase to date is just five million horse power, so that the actual rate of increase for the past twelve months stands considerably above the average. The total development to the end of the year 1931 is 6,666,337 horse power, or about 15½ per cent of the total recorded water power resources available.

Figures of such magnitude are difficult to realise by any effort of mental vision. Translated into terms of coal fuel at the most recently determined equivalent of 5¼ tons of coal per horse power in continuous operation throughout the year, the existing installations of the Dominion represent a potential saving in coal consumption of approximately 35 million tons per annum, an economy of notable dimensions, especially in a country where nearly all coal has to be imported from abroad. Measured in terms of population, there is 644 developed horse power per 1000, and in one province (Quebec) the proportion is 1 081 horse power per head. On the financial side, the capital invested in the various undertakings is estimated at more than 1514 million dollars. The accompanying table gives a detailed analysis

of the allocation of power among the leading industries for each of the provinces of the Dominion.

The distribution of energy among the provinces is, as might be expected, far from uniform. Quebec and Ontario, industrial regions of high productivity, possessing no natural deposits of coal within their borders, make by far the largest demands for

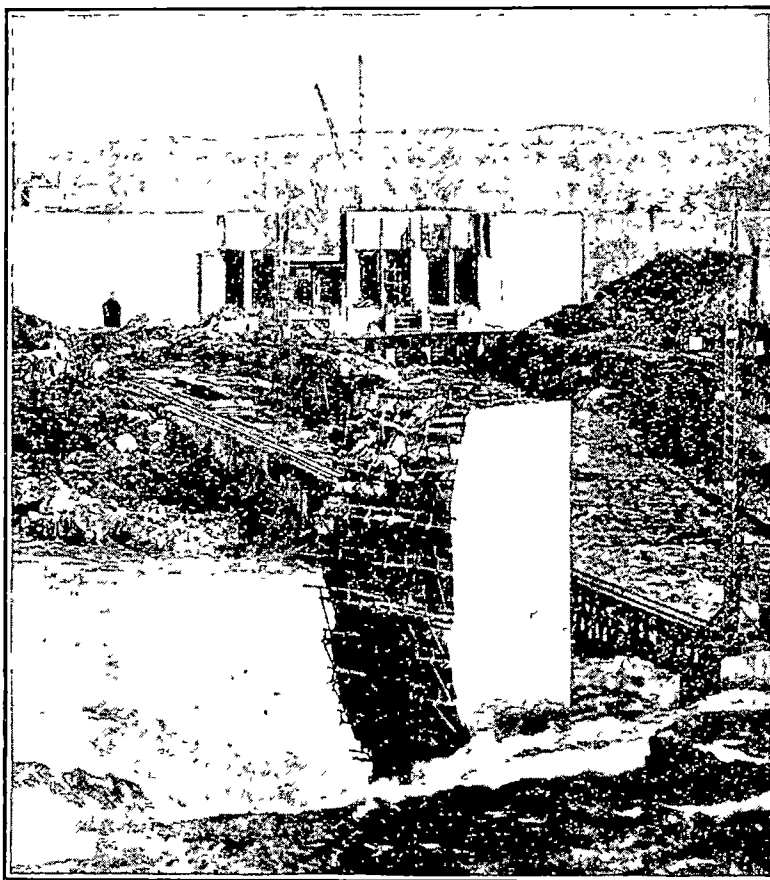


FIG 1—The 'obelisk' for damming the main stream of the Saguenay River in course of construction. By courtesy of the High Commissioner of Canada.

DEVELOPED WATER POWER IN CANADA. DISTRIBUTION  
BY PROVINCES AND INDUSTRIES

| Province                         | Turbine Installation         |                         |                     | Horse Power |
|----------------------------------|------------------------------|-------------------------|---------------------|-------------|
|                                  | In Central Electric Stations | In Pulp and Paper Mills | In Other Industries |             |
| British Columbia                 | 489,360                      | 105,800                 | 60,832              | 655,992     |
| Alberta                          | 70,320                       |                         | 212                 | 70,532      |
| Saskatchewan                     | 42,000                       |                         | 35                  | 42,035      |
| Manitoba                         | 390,925                      |                         |                     | 390,925     |
| Ontario                          | 1,803,923                    | 240,880                 | 94,402              | 2,145,205   |
| Quebec                           | 2,742,425                    | 222,160                 | 134,745             | 3,100,330   |
| New Brunswick                    | 104,960                      | 19,778                  | 8,943               | 133,681     |
| Nova Scotia                      | 84,202                       | 12,378                  | 15,419              | 111,999     |
| Prince Edward Island             | 376                          |                         | 2,063               | 2,439       |
| Yukon and North-West Territories |                              |                         | 13,199              | 13,199      |
| Dominion                         | 5,734,491                    | 600,996                 | 330,850             | 6,666,337   |

power, and, fortunately, possess correspondingly large hydraulic assets. Quebec has an aggregate installation of 3,100,330 horse power, of which 382,200 horse power was provided last year. Ontario's aggregate is 2,145,205 horse power, of which 58,200 horse power was last year's contribution. These two provinces stand far ahead of all the others, the nearest to them being British Columbia with a present installation of 655,992 horse power. The total water power resources of the Dominion, estimated on the basis of the information available at the present time, are of the order of 43 or 44 million horse power.

To review the development of the respective provinces would take too long, and would involve a recital of sites and powers which would occupy more space than can be spared. From the con-

siderable number of installations, the following example is selected for brief notice, as it exhibits some features of remarkable interest. It is the largest of the undertakings brought to completion during the twelve months under review, and it is notable alike for the gross capacity (260,000 horse power) of the station and for the magnitude (65,000 horse power) of each of the four units of operating plant.

Chute à Caron is the name of a fall on the river Saguenay, in the province of Quebec, which runs from Lake St John and discharges into the St Lawrence. An earlier development at Isle Maligne,

second is known as the Shipshaw project. The former has involved the construction of a massive concrete dam across the river Saguenay, just above the Chute à Caron rapids, and the temporary diversion of the river through the power-house until such time as the Shipshaw works are completed, when the river will be restored to its former bed and the Chute à Caron station will be used merely as a stand-by. Temporarily, by the development of a fall of 151 ft, it renders available a total of 260,000 h p, while the ultimate achievement of the Shipshaw project, with its comprehensive fall of 205 ft, will raise the total to a million h p.

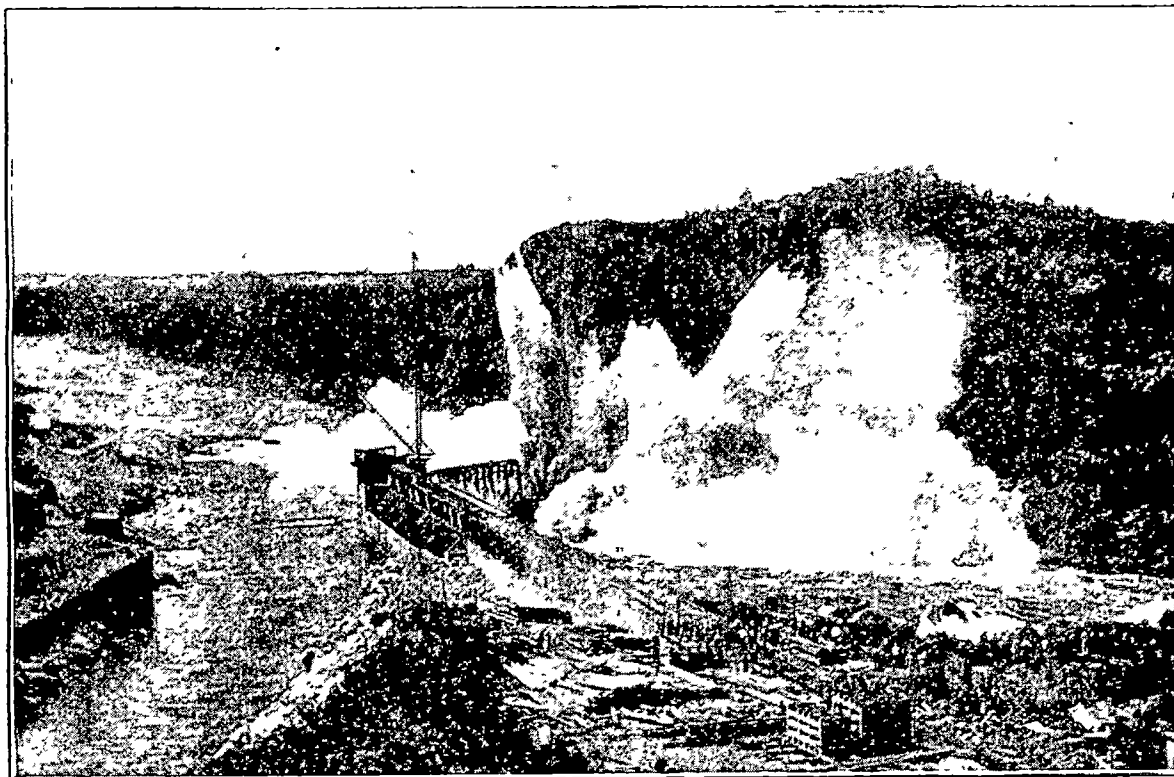


FIG 2.—Damming the main stream of the Saguenay River. By courtesy of the High Commissioner of Canada.

at the head of the same river, has previously been noticed in NATURE.<sup>2</sup> The Isle Maligne installation is the property of the Quebec Development Company, and has a capacity of 540,000 horse power. Completed some five years ago, it represents the exploitation of about one-third of the total fall of the Saguenay River below Lake St John, that is to say, from 90 ft to 119.5 ft, according to the water level of the lake. In the original programme of development for the river, it had been contemplated that the remaining 208 ft of fall would be developed in a single step, with an initial capacity of 800,000 h p, and an ultimate capacity of 1,000,000 h p. The delay involved in the single-step programme made it desirable, on economical grounds, to take advantage of a combination of natural conditions which permitted of more convenient development in two steps. The first of these is the Chute à Caron undertaking, and the

One of the most remarkable features\* of the undertaking, probably unique in engineering practice, was the instantaneous damming of the main stream, which is about 100 ft wide by 35 ft deep, by means of the fall of a monster block, or monolith, of solid reinforced concrete, weighing 10,950 tons. The 'obelisk', as it was termed for convenience (Fig 1), was built in a vertical position on a small rocky island connected to the south bank of the river by a coffer-dam. It had a height of 92 ft, a width of 45 ft, and a depth of 40 ft at the centre to the underside of its curved base. It contained 5400 cubic yards of concrete and 50 tons of steel reinforcement. The pedestal on which it was poised before its overturn, was made in the form of two piers, the smaller of which, on the river

\* The particulars relating hereto are taken from an extract of a paper read by Mr J. W. Rickey, before the Engineer Society of Western Pennsylvania, and published in the *Canadian Engineer* of Jan. 26, 1932.

side, was, at a prearranged moment, demolished by blasting, allowing the unbalanced obelisk to roll forward over the cylindrical surface of the remaining pedestal and fall prone into the torrent, in this way completely arresting in a few seconds a volume of nearly 2000 cubic feet of water racing at a velocity of about 30 ft per sec. A view of the incident is given in Fig 2.

An operation of so unprecedented a character involved certain intricate problems, the calculated solutions of which were checked by the construction of a model to a scale of 1/50 in the Hydraulic Laboratory of the Carnegie Institute of Technology, Pittsburgh. Recording devices on the model gave practical demonstration of the effect of the water

cushion on the impact, and of the dynamic stroke of the stream against the obelisk before reaching the bed. It is satisfactory to learn that the whole operation of overturning the huge mass was carried through without a hitch of any kind. After the explosion of the charge of dynamite, the obelisk fell exactly in accordance with the calculations, and landed on the river bed within an inch of its destined position. The impact recorders showed that almost the whole (99.6 per cent) of the energy of the falling mass was absorbed by the cushion provided by the water.

<sup>1</sup> Hydro electric Progress in Canada in 1931, Report No 1571  
Water Power Resources of Canada, Report No 1573  
<sup>2</sup> NATURE, July 27, 1929

### The Hereditary Transmission of Acquired Characters\*

By Prof J B S HALDANE, F R S

IN another series of experiments which MacBride quotes, Harrison induced a race of the willow gallfly, *Pontania salicis*, to change its food plant from one species of willow to another. He first showed that a race taken from *Salix phylicifolia*, when given the choice of 21 species or subspecies of willow, confined themselves almost wholly to the original plant and to the related *Salix Andersoniana*. However, in addition, 3.5 per cent of the eggs were laid on *Salix rubra*. In two out of three years the galls on this latter plant failed. In one year seven of them reached maturity. In a second experiment, Harrison let loose gallflies from *Salix Andersoniana* in a patch of willows consisting entirely of *Salix rubra*. The eggs were perforce laid on the latter, and the large majority of the galls aborted in the first two years, but fewer in the next two. At the end of the fourth year, *Salix Andersoniana* was planted near the patch, but in the course of two years no galls were formed on it.

There can be no question of the importance of Harrison's demonstration that a race of insects can in this way acquire a new character. But the reasons for this event are not so clear. Wheeler (who as a Lamarckian cannot be accused of bias) regards the choice of food in which to lay eggs as determined largely by memory of larval surroundings, and particularly smells. The other factor in successful colonisation is the ability of the larva to eat and digest its food. Now, as in the first years most of the galls aborted, it would seem likely that the larvæ were being very stringently selected. The capacity to grow on *Salix rubra* is rare in the original race. Only in 7 out of 57 galls on it did the larvæ mature. Until a definite proof of Lamarckian inheritance has been given, in any case, we are justified in putting down the observed facts to selection, perhaps aided by individual (not racial) memory. We know that variation occurs in man with regard to idiosyncrasy to foodstuffs, and there is evidence that it is inherited, the same is very probably true of insects.

\* Continued from p 819

Finally, MacBride cites Metalnikoff's experiments on the acquired immunity of the moth *Galleria mellonella* to a bacillus. I quote one sentence from MacBride's account: "After three or four days the survivors were counted and allowed to develop and become the parents of the next generation." Unless *Galleria*, unlike men, mice, and other species investigated, does not possess any innate variability in its resistance to disease, there has clearly been stringent selection, and we need not be surprised that a relatively resistant race has been developed.

I pass over several other cases where apparently Lamarckian effects have been due to infection, and Kammerer's experiments, which terminated in his suicide, to the very remarkable results obtained by McDougall on rats. Unlike the other workers here cited, he began with an approximately pure line of rats which had been inbred for many generations. He also took considerable precautions to avoid selection. Unfortunately, the procedure of training was twice changed during the experiment, so I shall only describe the latter half.

The rats at an age between three and four weeks were dropped into a tank of water in which two turnings led to platforms covered with wire gauze by which they could emerge. One of these (alternately on the right and left) was illuminated, and a rat stepping out of the water on to it received an electric shock. Each rat was dropped in six times daily until it learned to avoid the illuminated platform. Learning was regarded as complete when this occurred on twelve successive trials. After twelve generations, all but one of which had been trained under slightly different conditions, but had shown a decided increase in educability, the procedure was finally standardised. In nine generations the average number of errors fell from 80 to 25, and the number made by the best rat from 42 to 3. In an experiment on a related group, the number of errors fell from about 170 in the first generation to 114 in the fifth. Finally, the worst performers were selected during two generations, but in spite of this, the time needed for training fell.

To obviate the possibility of tradition, mothers of a slightly trained stock were mated first with slow-learning and then with quick-learning males. The first mating gave an average number of 166 errors, the second of 62. The character acquired appears to be caution. It does not seem to be general intelligence, general timidity, or a specific fear of the bright gangway.

One very important point which emerged was that the progeny of the trained rats at first showed much greater variation in learning power than those of the untrained. If capacity for learning is inherited within the group (which could be ascertained or disproved from McDougall's records were they published in full), the process of change would have been greatly accelerated if selection had also taken place, if in fact the spread of acquired variations through the population had been aided by selection, as Darwin thought was the case in ordinary evolution.

Now, while it is clear that McDougall's experiment is in a class by itself, it has been criticised by Sonneborn, among others. Sonneborn notes that the intensity of the shock varied considerably and was not measured, and that McDougall found that rats subjected to light shocks took nearly three times as long to learn as when the shocks were heavy. So a progressive increase in the shock intensity could account for McDougall's results. He further points out that, if the method of choosing two rats 'at random' from a litter was to take the first two available in a cage, this would tend to select rats of a particular psychological disposition. Various other criticisms can be made. Hence it would seem that, while one must admit that McDougall has made out a *prima facie* case, a suspension of judgment is not unreasonable before we regard him as having demonstrated a principle in evolution which is unsupported by other evidence of the same calibre. It is, moreover, worth noting that in another experiment, broken off after four generations, McDougall found that the time needed for training increased in successive generations. He put this down to an increase in timidity, thus contriving to eat his cake and have it.

If we reject Lamarckism, we are, I think, left in the position termed neo-Darwinian, but concisely stated by Lucretius, one of the greatest minds of all history, two thousand years ago (I owe the quotation to Dr C. D. Darlington)\*. Genes, the *genitalia corpora* of Lucretius, reproduce themselves at each cell division, and are handed down from parent to offspring. The genes in an organism determine how it will develop and behave in a given environment. The process of reproduction

of the gene is not perfect. Occasionally a gene produces another gene of a different type. This process is called mutation, and has never been shown to be adaptive, still less to perpetuate an acquired habit. Changes in the number of genes (for example, by doubling the chromosome number) also occur. Evolution is due to the fact that only a few of the possible combinations of genes survive. Were this not so, it would have been a mere orgy of variations without any particular trend.

I should like emphatically to protest against the view that the contest between Lamarckism and neo-Darwinism has anything to do with that between vitalism and mechanism. It would be quite possible to explain McDougall's results on thoroughly materialistic lines if the increased use by his rats of certain parts of the brain liberated specific substances into the blood, and these substances acted on the genes concerned with the elaboration of cerebral structure. Again, the neo-Darwinian may be a thorough-going vitalist, regarding each gene as an elementary living thing, contributing to the communal life of the cell and the federal life of the organism. He differs from the Lamarckian in believing that the gene has a very high degree of autonomy. There is no more reason to describe him as a mechanist than to dub a man an anarchist if he thinks that Parliament should not reverse the decisions of the London County Council. Similarly, a Lamarckian can be a vitalist, and a Darwinian a mechanist, or, like myself, he may refuse to take either point of view.

Further, it is often stated that a refusal to admit that conscious purpose has played any important part in evolution is a gloomy and even immoral point of view. McDougall writes of "the Cimmerian darkness in which Neo-Darwinism finds itself", and I admit that a theory which (like that of stellar structure) is largely based on integral equations is inevitably lacking in popular appeal. Nevertheless, the exact opposite seems to me to be the case. It has taken about a thousand million years for evolution to produce man, and the process has not only been slow but also often cruel. If mind had been an important evolutionary agent, there would be some ground for pessimism. If, on the other hand, it is only in our own time that the purposive guidance of the evolutionary process is becoming possible, then the outlook is altogether brighter. But if this is so, it is all the more our duty to examine as critically as possible the various evolutionary theories and to reject those which do not rest on a solid basis of observation.

From the human point of view the implications of the neo-Darwinian point of view were forcibly stated by the prophet Ezekiel (ch 18, v 2).

"What mean ye, that ye use this proverb concerning the land of Israel, saying, The fathers have eaten sour grapes, and the children's teeth are set on edge? As I live, saith the Lord God, ye shall not have occasion any more to use this proverb in Israel."

If we accept this point of view, each of us starts

\* The quotation from Lucretius is a moderate statement of his doctrine. He sometimes stated it in an obviously false manner, for example, in his "Histoire naturelle des animaux sans vertèbres" we read:

"Quatrième loi. Tout ce qui a été acquis, tracé, ou changé dans l'organisation des individus, pendant le cours de leur vie, est conservé par la génération et transmis aux nouveaux individus qui proviennent de ceux qui ont éprouvé ces changements."

For example, children acquire a full knowledge of their parents' language without education, and Jews are born circumcised. Lamarck's mistaken views on heredity do not, of course, lessen the greatness of his work on evolution. But it is unfortunate that many French biologists tend to exalt Lamarck and neglect another great Frenchman, de Vilmorin, whose discovery of pure lines laid the foundation of modern genetics.

afresh with the genetical constitution derived from his or her parents. The way in which his ancestors have employed their talents is irrelevant. The slum child, if of sound constitution, will not be handicapped by the bad environment of his parents provided he is transplanted early enough. Nor,

on the other hand, are the effects of university education inherited. By the process of death and reproduction the species throws off some of the intolerable burden of the past. Evolution is thus possible for the race at a rate and to an extent which would be impossible for the individual.

### Electrical Conductivity of Metals at the Lowest Temperature \*

WITH the fairly large supplies of helium now available it is comparatively easy by the liquefaction of this gas to reach temperatures so low as  $1^{\circ}\text{K}$  ( $-272^{\circ}\text{C}$ ). At this low temperature a few of the metals become perfect conductors of electricity. Most of them, however, still exhibit, when so cooled, a decreasingly small but still quite measurable resistance to the passage of a current.

In 1911, Kamerlingh Onnes at Leyden, while carrying out researches at low temperatures with the aid of liquefied helium, discovered that mercury, when cooled down and solidified with liquid helium, suddenly and abruptly at about  $4.2^{\circ}\text{K}$  became what is now designated as a superconductor of electricity. At temperatures below  $4.2^{\circ}\text{K}$  mercury offers no measurable resistance to the passage of a current. Currents of electricity started in a ring of mercury in the superconducting state will continue apparently undiminished in intensity while the metal is in that state. The duration of these persistent induced ring currents is limited only by the length of time the cooling agent, liquid helium, will last. Other metals that exhibit this superconducting property if made sufficiently cold are lead, tin, indium, gallium, thallium, tantalum, titanium, and niobium.

The transition temperature for the passing of a metal from the ordinary conducting to the superconducting state is not a constant but varies with the metal. For mercury it is  $4.2^{\circ}\text{K}$ , for lead  $7.2^{\circ}\text{K}$ , tin  $3.72^{\circ}\text{K}$ , tantalum  $4.5^{\circ}\text{K}$ , thallium  $2.39^{\circ}\text{K}$ , indium  $3.4^{\circ}\text{K}$ , gallium  $1.07^{\circ}\text{K}$ , and niobium  $8.2^{\circ}\text{K}$ . Some alloys and chemical compounds of the metals also exhibit the superconducting phenomenon. Copper sulphide, for example, does so, though neither of the constituent elements is a superconductor. The nitrides and carbides, borides and silicides of several of the metals such, for example, as molybdenum, tungsten, tantalum, zirconium, and niobium, are also superconducting at sufficiently low temperatures.

The addition of metals of the bismuth group to superconducting metals has been found, speaking generally, to raise their transition temperature. Bismuth added to lead raises the transition temperature from  $7.2^{\circ}\text{K}$  to  $8.8^{\circ}\text{K}$ , carbon raises that of niobium from  $8.2^{\circ}\text{K}$  to  $10.5^{\circ}\text{K}$ . Gold alloyed with bismuth becomes superconducting at  $1.94^{\circ}\text{K}$ , whereas neither constituent alone becomes superconducting even at the lowest temperatures obtainable.

The application of mechanical stresses such as

those of torsion and tension raise the transition temperature of a superconducting metal, but the application of a magnetic field delays the appearance of superconductivity in a metal, and causes it to appear at a lower temperature than normally.

If a metal in the superconducting state be subjected to a gradually increasing magnetic field, a critical field strength is reached when electrical resistance reappears in the metal. The strengths of the critical fields required for different superconductors vary; an alloy of bismuth and lead, for example, at  $1.2^{\circ}\text{K}$  requires a magnetic field of 20,000 gauss to restore the property of electrical resistance, while metallic thallium at the same temperature requires a field of only 15 gauss.

Since the electrical resistance of superconducting metals is zero, no heat is produced when electrical currents are passed through them. Currents of high intensity can therefore be passed through superconducting wires of small diameter without melting them. Electric currents of more than 1000 amperes have been so obtained in wires of small cross-section. The factor that imposes a limiting value upon the current strength is the magnetic field set up in the wire by the current itself. A critical value is reached when resistance is restored to the wire by the magnetic field.

Interest in the problem of superconductivity in metals recently received a stimulus through the discovery by Prof. McLennan and his collaborators that the transition temperatures with alternating electric fields applied are not the same for superconducting metals as when direct currents are passed through them. In a series of experiments with a coil of tin wire, drawn to a diameter of 0.3 mm, it was found that with direct currents the resistance of the coil began to decrease abruptly at  $3.76^{\circ}\text{K}$  and disappeared completely at  $3.70^{\circ}\text{K}$ . Experiments with the same coil with currents of frequency  $1.1 \times 10^7$  per second gave for the corresponding temperatures  $3.67^{\circ}\text{K}$  and  $3.61^{\circ}\text{K}$ , that is, superconductivity did not begin to appear until a temperature was reached that was below the one at which it was complete in the case of the direct current experiments. Further experiments with higher frequencies revealed depressions of the critical transition temperature, increasing in amount with the frequency. Extrapolation of the transition temperature-frequency curve, which appeared to be linear for the higher frequencies, gave  $10^9$  per second for the frequency corresponding to  $0^{\circ}\text{K}$ .

With tantalum wires, results were obtained similar in character to those found with wires of tin and of lead. Experiments with tin wire coils

\* Substance of the Friday evening discourse delivered by Prof. J. C. McLennan, F.R.S., at the Royal Institution on June 3.



showed that the observed depression of the critical temperature was not dependent upon the magnitude of the high frequency currents in the coils, and was therefore attributable neither to the heating of the coils above the temperature of the surrounding liquid helium nor to the effect of the magnetic field of the currents. Experiments with wires of different sizes made with currents of the same frequency showed that the depression of the transition temperature was not a direct function of the skin effect. It would appear, then, to be a function of the frequency of the current in the metal alone.

The conclusion is drawn that polarisation and orientation phenomena are involved in the production of the superconducting state in metals, and that this electrical state is somewhat analogous to the saturated magnetic state obtainable with ferromagnetic metals. A new road of attack upon the problem of superconduction in metals seems to be opened up by the discovery of this frequency disturbance of the critical transition temperatures.

In the course of his lecture, Prof McLennan gave

a demonstration of the persistence of an electrical current in a metal at the temperature of liquid helium. Prof W H Keesom, who succeeded Kamerlingh Onnes at the Cryogenic Laboratory at Leyden, liquefied a quantity of helium during the morning of June 3. This helium was collected in a large Dewar flask supported in a second Dewar flask filled with liquid air, these two were then supported in a third Dewar flask also filled with liquid air. A small ring of lead about an inch in diameter and about an eighth of an inch in cross section was placed in the bottom of the inner flask immersed in the liquid helium and a current of several hundred amperes was induced by an external magnetic field in this lead ring. Prof Keesom's assistant, Mr Flim, carrying the Dewar flasks, was brought by aeroplane by Colonel the Master of Sempill to the aerodrome at Hanworth and thence by motor car to the Royal Institution in time for Prof McLennan's discourse. By this means, liquid helium and an electric current in a superconducting metal were exhibited for the first time in England.

### Obituary

THE HON MRS HUIA ONSLOW

MRS ONSLOW was a distinguished plant biochemist. As Muriel Wheldale, she went to Newnham College, Cambridge, in 1900, from King Edward's School, Birmingham, and in due course obtained a first class in Parts I and II of the Natural Sciences Tripos. She was appointed to a Bathurst Studentship in 1904, and afterwards became a research fellow and associate of her College. For two years she was a research worker at the John Innes Horticultural Institution. In 1926 she was appointed to a University lectureship in plant biochemistry at Cambridge.

Mrs Onslow's scientific work was devoted mainly to two lines of inquiry: first, to the chemistry of anthocyanins, with special reference to the behaviour of these pigments in the genetics of flower colour; secondly, to the nature of the oxidase systems of plants. During the years 1903-9 she made a very thorough study of colour inheritance in *Antirrhinum majus*. As a result of this study she advanced the original suggestion that anthocyanins are formed from the glucosides of flavones, her view at that time being that the conversion was due to the action of an oxidase. In 1913-14 she isolated and studied chemically the antirrhinum pigments. This work was done before the classical studies of Willstätter were published, and though her views have not all been confirmed in detail, she was a pioneer in the subject, and in particular she was one of the first to discuss in acceptable terms the factors of inheritance from a chemical point of view.

To the study of plant oxidase systems Mrs Onslow devoted much labour and made in particular one contribution of much interest. Bach and Chodat had shown that the tissues of some plants yield extracts capable of directly inducing certain oxidations such as the blueing of guaiacum, while

others do so only after the addition of a peroxide. The latter were held to contain a peroxidase enzyme alone, while the former contain a second factor capable of replacing the peroxide. Mrs Onslow showed that this second factor is a catechol derivative, and found after an exhaustive study that it was present in all plants of the former class and absent in those of the latter. She then showed that plant extracts can convert monophenolic compounds, for example, *p*-cresol, into diphenolic compounds—an observation of importance to the later development of the subject. In recent years she was engaged in supervising an exhaustive research upon the respiration of apples, the work being done in relation with the problems of cold storage.

In 1916, Mrs Onslow published a monograph on the anthocyanins, and in 1931 appeared Part I of her "Principles of Plant Biochemistry". Of the latter, the second part is not published. Her last contribution was the review of the recent literature on anthocyanins which appeared in the issue of NATURE of April 23.

In 1919 she married the Hon Huia Onslow, whose devotion to scientific and artistic labours after almost complete disablement by a serious accident won deep admiration from all who were privileged to know him. The companionship of one who shared his interests and understood his intellectual needs added happiness to his latest years.

Mrs Onslow was deeply devoted to the subject of her study, and having a gift for clear exposition, she taught it with great success. She had a passionate love for travel, and of late years spent her holidays in exploring the more inaccessible parts of Central Europe. She leaves a widowed mother, whose sole companion she had been for a number of years.

## News and Views

## King's Birthday Honours

THE King's birthday honours list contains the names of the following scientific workers and others associated with scientific work — *Viscount* The Right Hon Lord Buckmaster, chairman of the Governing Body of the Imperial College of Science and Technology *Knights Bachelor* Dr H B Brackenbury, chairman of the Council of the British Medical Association, Mr R H Davis, governing director of Messrs Siebe Gorman and Co, Ltd, inventor of the Davis submarine escape apparatus and of a submersible decompression chamber for use in deep sea diving, Dr Robert L Mond, president of the Faraday Society and of the Egypt Exploration Society, Mr MacPheison Robertson, for services in connexion with the Antarctic Research Expedition, 1929–31, Prof W Wright Smith, regius professor of botany in the University of Edinburgh, and regius keeper of the Royal Botanic Garden, Edinburgh *CB* Dr C V Drysdale, director of scientific research, Admiralty *CSI* Brev-Col F P Mackie, director of the Pasteur Institute and Medical Research Institute, Shillong, Assam *CMG* Mr H E Hurst, director-general of Physical Department, Ministry of Public Works, Egypt, Mr F A Stockdale, agricultural adviser to the Secretary of State for the Colonies *CIE* Mr R D Richmond, chief conservator of forests, Madras *CBE* Mr A W Clapham, secretary of the Society of Antiquaries, Dr Eleanor Constance Lodge, until recently principal of Westfield College, University of London, Mr R J Reynolds, honorary adviser in radiology to the Ministry of Pensions, Prof R G Stapledon, professor of agricultural botany, University College of Wales, Aberystwyth, and director of the Welsh Plant Breeding Association *OBE* Mr W G Fairweather, director of surveys, Northern Rhodesia, Mr H E Flint, deputy conservator of forests, Burma, Mr A M Henshaw, a member of the Safety in Mines Research Board, Mr F T Morehead, deputy conservator of forests, Insein, Burma, Mr H B Owen, medical superintendent and principal, Medical School, Mulago, Uganda Protectorate, Mr G Shearing, principal scientific officer, Naval Signal School, Portsmouth, Dr H C Sinderon, dean of the Royal College of Medicine, and physician of the Royal Hospital, Ministry of the Interior, Iraq, Mr C W Scott, forest economist to the Government of Burma, Major D R Thomas, chemical examiner to the Government of the Punjab, Mr G W M Woods, Indian Forest Service, Burma *MBE* Mr D W D'Silva, extra assistant conservator of Forests, Burma, Mr O E C Judd, deputy director of surveys, Bihar and Orissa, Mr H Kavanagh, timber assistant, Forest Department, Burma, Mr A Marshall, superintendent, Bacteriological Laboratories Section, Wellcome Tropical Research Laboratories, Khartoum Mr E Muir, research worker in leprosy at the Calcutta School of Tropical Medicine and Hygiene, has been awarded a bar to his Kaiser-i-Hind medal

## Honour for Sir Aurel Stein

IT is announced that the Council of the Royal Asiatic Society has awarded the gold medal of the Society "in recognition of distinguished services in Oriental Research" to Sir Aurel Stein, the well-known traveller and archæologist. For more than thirty years Sir Aurel Stein has been engaged in travel and exploration in Central Asia, with the authority and under the direction of H M Indian Government. His investigations among the sand-buried cities of Eastern Turkestan and Western China, where he shares with Sven Hedin the honour of pioneer exploration, have recovered for archæological and historical science a vast treasure of literary and official records, as well as of objects which reveal the art and culture of the early peoples of the Tarim basin. The remarkable achievements of their art in two directions in particular are demonstrated in two special publications dealing with this material—"Ancient Figured Silks Excavated at Ruined Sites of Central Asia" (1920) and "Ancient Buddhist Paintings from the Caves of the Thousand Buddhas on the Westernmost Border of China" (1921). The results achieved in the journeys carried out by Sir Aurel Stein under the order of H M Indian Government have been described in a number of carefully prepared and scholarly publications, of which the best known are "Sand-buried Ruins of Khotan" (1907), "Explorations in Central Asia" (1906–8), "Ruins of Desert Cathay" (1912), and "Serindia" (1921), which for a travel book achieved the almost unique distinction of becoming a 'collector's book' saleable at a high premium within a short time of publication. In another field, "On Alexander's Track to the Indus" (1929) deals with exploration and topographical research in the lands of the Indian north-west frontier. Sir Aurel Stein received the honour of K C I E in 1912.

## Sir William Crookes (1832–1919)

ON June 17 occurs the centenary of the birth of Sir William Crookes, who was born in London in 1832 and died in Kensington on April 4, 1919, at the age of eighty-six. Save for a year or two, all his life was spent in London, and at his death he was buried in Brompton Cemetery. The son of a tailor, he was sent for a time to the Grammar School, Chippenham, but his scientific training began when at the age of sixteen he became a student under Prof A W Hofmann at the Royal College of Chemistry. For four years he was one of Hofmann's assistants. He then spent a year as meteorologist at the Radcliffe Observatory, Oxford, and another as lecturer in chemistry at the Training College, Chester. At twenty-four years of age he married and returned to London, which henceforth became his home. Few men of science have had a more active or distinguished career than Crookes. For sixty years he was recognised as a most skilful experimenter, and he was likewise known for his intellectual independence and his wide interests. He first became well known through his

discovery in 1861 of the element thallium, a specimen of which was exhibited at the Hyde Park Exhibition of 1862. His subsequent researches extended to many branches of chemistry and physics, and his work often resulted in important applications of science to the arts and manufactures.

WHILE Crookes will probably be remembered longest for his researches on spectroscopy, on radiation, on the discharge of electricity in high vacua, and on the rare earths, much of his earlier work related to problems in practical chemistry. In 1859 he founded the *Chemical News*, of which he was editor until 1906, and his books included works on beet sugar, dyeing, metallurgy, manures, and similar subjects. In 1887 he served as president of the Chemical Society. Of the Royal Society he was a fellow for fifty-six years, being admitted F.R.S. in 1863, serving as foreign secretary from 1908 until 1912, and finally being elected president for the two years 1913 and 1914. He had already served as president of both the Institution of Electrical Engineers and the British Association, and it was in his address to the latter in 1898 he made his notable references to the problem of the world's wheat supply. Among his many distinctions were those of a place in the Paris Academy of Sciences, the honour of knighthood conferred on him by Queen Victoria in 1897, and the Order of Merit. There are portraits of him at the Royal Society and the National Portrait Gallery, his biography has been written by Dr. Fournier d'Albe, and an appreciation of his work by Prof. P. Zeeman, with a portrait, appeared in *NATURE* of Nov. 7, 1907, in our series of "Scientific Worthies."

#### Jubilee of St. Gothard Tunnel

ON June 1 the jubilee of the official opening of the St. Gothard Tunnel was marked by the unveiling by Signor Motta, President of the Swiss Confederation, of a sculpture entitled "The Victims of Work." This is a bronze casting of a sculpture made fifty years ago by the artist, Signor Vincenzo Vela, who intended it to decorate the entrance to the tunnel. The St. Gothard was the second of the five great alpine tunnels to be constructed, and it is the second longest. The first constructed was the Mont Cenis tunnel, driven by the engineers Sommeiller and Grattoni and opened in 1871. It is just over 8 miles long. The St. Gothard tunnel, constructed by Louis Favre (1826-79), who died in the tunnel of apoplexy, was begun in 1872, and is more than 9 miles long. The Arlberg tunnel through the Austrian alps, built a year or two after the St. Gothard, is  $6\frac{1}{2}$  miles long, the Simplon tunnel, opened in 1906, is  $12\frac{1}{2}$  miles long, and the Lotschberg tunnel, completed in 1911, is  $8\frac{1}{2}$  miles long. The St. Gothard tunnel connects northern and central Switzerland with Canton Ticino. Its northern opening is at Goschenen and its southern at Airolo, its central point is 3786 ft. above sea-level. The railway line from Zurich to Chiasso at the Italian frontier, which passes through the St. Gothard, was electrified about ten years ago, and trains cover the distance of 151 miles in 4 hr. 35 min.

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#### Television Transmissions of the Derby

ON June 1 a television image of the Derby was shown at the Metropole Cinema, Westminster, to an overflowing audience. The television transmitter was situated on the racecourse adjacent to the winning post, and the audience at the Metropole were able to see the horses as they walked past the grand stand for the parade and again as they flashed past the winning post at the finish of the race. Vision was accompanied by a running commentary given by a commentator standing in the television caravan. The apparatus at the transmitter comprised a mirror drum revolving at 750 r.p.m. This revolving mirror drum casts a succession of images over three photo-electric cells, each of the mirrors of the drum being set at a slightly different angle from that of the preceding one, thus causing the image to be divided into a succession of strips. A drum with 30 mirrors was used, and the ratio of the picture for each photo-electric cell was 3 by 7, the picture received at the Metropole being constituted by three such pictures projected in three adjacent zones to form one composite image.

THE picture ratio was kept at 3 by 7 and the speed at  $12\frac{1}{2}$  so that the centre zone of the picture could be broadcast by the B.B.C., and this broadcast took place in the national programme simultaneously with the demonstration to the cinema audience. The receiver in the cinema comprised a mirror drum similar to that at the transmitter, three small arc lamps and three Kerr cells supplying the modulated light for the three zones. The image was projected on a translucent screen approximately 10 feet by 8 feet. During last week transmissions have been supplied from the Baird Studios in Long Acre on a single zone, and a number of representative people appeared before the television transmitter in Long Acre and addressed the audience at the Metropole from the television screen. Among those who appeared were Sir Ambrose Fleming, Sir Richard Gregory, and Sir Ian Hamilton.

#### World Production of Metals and Coal

THE speech recently delivered by Sir Robert Hadfield at the annual general meeting of Hadfield's, Ltd., gives some interesting statistics for the total production of gold and silver from 1493 to 1931, and of copper, iron, and coal from 1800 to 1931. The world's production of gold in these 438 years amounted to 32,500 long tons, valued at £5,100,000,000, for silver the corresponding figures are 397,000 tons and £2,900,000,000. For copper, iron, and coal the corresponding figures for the period 1800-1931 are 39,500,000, 2,895,000,000, and 52,000,000,000 tons and £2,200,000,000, £16,000,000,000, and £39,000,000,000. The comparative production is illustrated in a striking model prepared by Sir Robert Hadfield, which shows that the total production of gold in these periods would go in a cube of no more than 40 feet side, whereas silver would require a cube the side of which was 111 ft. long, copper 530 ft., iron 2360 ft., and coal 11,200 ft.

### The Gold Standard

Compared with that of other metals the production of gold is insignificant, and recent events which have demonstrated the defects in the gold standard and induced many nations to come off the gold standard have led many people to wonder whether gold is a suitable metal to be used as a standard at all. The diagrams and models prepared by Sir Robert Hadfield enable us to visualise more clearly the extent to which gold can now be merely a basis for currency. On the other hand, while the output of gold according to expert opinion shows a marked tendency to decrease, the increasing volume of the world's trade tends to augment the demand for gold as a basis for currency under our old systems of currency. In addition, the concentration of 75 per cent of the gold stocks of the world in the United States of America and France, where it is not used as the basis of so much money as in the countries from which it was withdrawn, has tended to accentuate the shortage. Without advocating a definite change or the adoption of bimetallism, Sir Robert suggested that the currency situation merited expert investigation and consideration by an authoritative international organisation such as the League of Nations. Certain reforms have in fact already been suggested by the League of Nations' Gold Delegation, and are outlined in a recent memorandum on "The Functioning of the Gold Standard", submitted by Dr Feliks Mlynarski, which equally with Sir Robert Hadfield's speech will repay study not only by economists but also by those who are endeavouring to arrive at an intelligent view of the world's financial and economic situation.

### Return of the *William Scoresby*

THE Royal Research Ship *William Scoresby* reached London on June 6 after a commission of nineteen months in the service of the "Discovery Committee". On her arrival at the East India Docks she was inspected by Mr E R Darnley, chairman of the committee, and by Vice-Admiral H P Douglas, who congratulated her personnel on the valuable scientific results which had been obtained. The work of the ship has been in the charge of Mr E R Gunther as chief scientific officer, with Commander T A Jolliffe, R N (ret'd), in executive command. After leaving England in November 1930, the *William Scoresby* was engaged for some months in oceanographic work on the whaling areas of the dependencies of the Falkland Islands, during which, with favourable ice conditions, observations were extended so far south as lat 70°. During the southern winter of 1931 she was occupied in a survey of the Humboldt current on the west coast of South America, taking fifteen lines of stations at right angles to the coast, at each of which observations were made on the plankton and on the physical characteristics of the water at different depths. The lines of stations cover an area extending from Cape Carranza to Santa Elena, a distance of about 2200 miles, and it is already clear that the results will provide much new information on the current and on the wealth of animal life that it contains. More recently the ship has been employed in a third and

final survey of the trawling grounds lying between the Falkland Islands and the American coast. The survey was carried out with great thoroughness, and is expected to yield adequate data on the commercial possibilities of the area.

### Mexican Earthquake of June 3

AN earthquake of unusual severity occurred early on June 3 in the west of Mexico. The towns most seriously damaged, as known at the time of writing, are Colima and Guadalajara, which lie between 270 and 290 miles to the west of Mexico City. At Colima seventeen persons were killed, and at Guadalajara and in the surrounding district more than thirty. In the whole area, the number of lives lost is estimated at more than four hundred. Manzanillo, about twenty-five miles west of Colima and on the sea coast, is believed to have suffered more severely than either of the above cities, but all communications with it have been interrupted. In Mexico City, three violent shocks were felt, though the damage there was slight. According to the Mexican Seismological Bureau, the epicentre was 400 miles from the capital, and thus, as it lay in the direction of Colima and Manzanillo, it must be submarine, as in so many other recent Mexican earthquakes, but somewhat farther to the west. As in other earthquakes of the same country, the area of damage was of great extent, suggesting that the depth of the focus was considerable.

### Challenge to Witches in West Africa

THE sequel to the challenge to witches issued by the Christian Council of the Missions of West Africa (see NATURE, March 26, p. 464) was described by the Bishop of Accra at the fifth festival of the Accra Diocesan Association, held at Westminster on May 31. He recalled that the Council, in its desire to show that a great deal of West African witchcraft is nothing but fraud, had offered the sum of £10 to any witch who, in the presence of a representative of the council, should perform one of their favourite tricks, such as eat a papaw from a distance, remove an article from a locked box, or change a person into a bird, beast, or fish. Up to the time he left Accra some weeks ago, the only reply to the challenge had come from a wizard, who was unable to come to Accra, but offered, if the Council would go to him, to kill a man at a distance of forty miles. The Bishop hoped the challenge would be taken up, though not exactly in that form. The witches of Africa, he said, form a great secret society which is a source of harm to the people. The Europeans are outside a wall drawn around the native, as it were, and know very little about what goes on within.

### Guthrie Lecture of the Physical Society

THE seventeenth Guthrie Lecture to the Physical Society will be delivered on June 17 at 5 P.M. at the Imperial College of Science and Technology, South Kensington, by Dr Max Planck, of Berlin, who will take as his subject "The Concept of Causality in Physics". Planck's greatest scientific achievements are the outcome of a study of thermodynamical principles and their multifarious applications. He was

thus led at the end of last century to the problems presented by full radiation, the last remaining problem of which, that of the energy distribution, he solved by formulating the quantum theory. The new feature in Planck's theory finds its expression in terms of the 'quantum of action', symbolised by the letter  $h$  (Planck's constant). This is a very small quantity, and the quantum theory consequently exhibits its special peculiarities only when applied to the small-scale phenomena for which it is needed. Applied to large-scale phenomena it coalesces, as it should do, with classical physical theory (in which we may include relativity). Planck's work has been creative in a higher sense than that of any of his contemporaries or predecessors, in that it has introduced, for the first time in the history of science, concepts that are really new.

#### Grasshopper Invasion in the United States

WE learn from Science Service, of Washington, D C (May 12), that a grasshopper invasion of exceptional severity is predicted to occur over the western United States. Field observations carried out over many years have shown that dry summers followed by relatively mild winters provide ideal conditions for these insects. The summer of 1930 was the driest on record, while that of 1931 was one of the hottest, as well as being a dry one. The past two winters have not been severe, and the consequence is that grasshoppers have become increasingly numerous in parts of the west. Last year, vast number of eggs were deposited in the ground, and now these eggs are hatching. The only possible control measure consists in the broadcasting of an arsenic-poisoned bran-mash bait, which the insects devour with avidity, and are killed thereby. The cost of its application over wide areas is large, and strong endeavours are being made to obtain funds from Congress that will enable the western farmer to apply this weapon in time to save his crops. Ample warning appears to have been given by entomologists, and others, with respect to what is described as the greatest grasshopper invasion of the past half-century, that is now threatening a large section of the country. It is obvious that only co-ordinated and very prompt action can alleviate the situation that is predicted to arise.

#### Celery Growing

IN view of the increase in consumption and production of celery in Great Britain, the Ministry of Agriculture has recently issued a new bulletin (No 47) on celery growing (London: H M Stationery Office 6d), in which the cultural methods used by the specialist growers and the results of scientific investigations obtained by the Midland Agricultural College are described. At one time the chief celery-growing district was the Isle of Axholme, but it is now produced to a considerable extent in Lancashire, the Fens of Cambridgeshire, and Huntingdonshire. A good celery soil must be deep, though easily worked, and contain a high percentage of organic matter. The water supply must be plentiful, but good drainage is essential. Besides a heavy application of farm-yard manure, a dressing of superphosphate is recom-

mended prior to planting, while a top dressing of sulphate of ammonia is commonly given in July. The plants are raised from seed in hotbeds, and after being bedded out in small plots for about two months, are transferred to the field about June, this final planting being a highly skilled operation. The time at which the celery is lifted depends on the variety and nature of the soil, but it may be ready as early as the end of August. The question of the best methods of grading and trimming for the market is receiving attention. The avoidance of disease is of the utmost importance in celery growing. If entirely clean seed is not procurable, it should be treated with some disinfectant, such as weak formalin, before being sown, and further, spraying of the plants both in the beds and in the fields should be regarded as a routine operation if a successful crop is to be obtained. For further particulars of such treatments, readers are referred to *Bulletin 25*, where celery diseases and their control are dealt with in detail.

#### Early Man in Java

DETAILS of the discovery of another new type of man in Java a few months ago have now been published, as is noted by Prof. Elliot Smith in a letter to the *Times* of June 3. The discovery was made by Mr C. Ter Haar, and the remains and circumstances of discovery are described by Mr F. F. Oppenorth, of the Geological Survey of Java, in the official publication of the Survey, issued at Batavia. In the course of the examination of the pliocene and pleistocene deposits of the Solo River valley, the greater part of a brain-case and two fragments of a second were found in a bone bed at Ngandong, more than twenty miles from Trinil, where Dr Dubois found the remains of *Pithecanthropus erectus* in 1891. The fossil bones of fauna associated with the Ngandong find point to a mid-pleistocene age. The brain-case is described as of a more advanced type than *Pithecanthropus*, and to resemble more nearly Neanderthal man and the Rhodesian skull. It is, however, definitely more primitive than either and probably more ancient. The name suggested for this new species of the human family is *Homo soloensis*.

#### Criminal Anthropology

CRIMINAL anthropology, which for some time has suffered an eclipse owing to ill-judged claims which had little or no foundation on sound observation, is once more attracting the attention of investigators. In *Scientia* for May, Prof. A. Mendes-Corrêa recapitulates views which he has put forward from time to time on the contribution which a re-orientated anthropological method can make to the study of criminals and to practical measures in dealing with delinquents. The method advocated by the author is based on a study of the individual, whether normal or abnormal, in reference to his individual psychic and moral make-up and his biological and sociological conditions. Measurements, somatic characters, mental tests, and other methods employed in dealing with delinquents and defectives are regarded as auxiliary rather than as primary methods of investigation in criminological research. Prof. Mendes-Corrêa regards

the new criminal anthropology as a development of the Lombrosian methods which has shed the defects of that school. On the other hand, a preliminary study of the American criminal by Prof E A Hooton, as reported by Science Service of Washington, more nearly approaches the methods of Lombroso, in that it endeavours to relate delinquency and physical type. Prof Hooton's conclusions are, however, based on a large number of observations extending over a considerable period. He is of the opinion that his material justifies the conclusion that criminals in the totality of their physical characters differ from civilians of the same ethnic type. Certain variations of physical type tend to be associated disproportionately with certain types of crime.

#### Regenerative Braking on Trains

THE paper on tramway regeneration by G H Fletcher which was read to the Municipal Tramways and Transport Association, the last instalment of a reprint of which appears in the March issue of the *Metropolitan-Vickers Gazette*, is of great interest to tramway engineers. In regenerative braking, when the electric tram or train is going downhill, its own momentum drives the motors of the car as dynamos, thus absorbing energy and acting like a mechanical brake. It also converts the gravitational potential energy into electrical energy which is restored to the line, helping the power station, and thus leading to economical working. The advantages of the regenerative system are the reduced energy consumption and the reduced wear of brake shoes and wheel tyres, and the consequent lowering of maintenance costs. The disadvantages are that the motors are larger and more costly. There are many examples of remunerative regenerative braking abroad in mountain railways and on lines where the gradients are heavy. The Metropolitan-Vickers Company has equipped two sample tramcars on the Manchester and Glasgow corporation systems respectively with regenerative control. The equipment enables the kinetic energy of the train to be recovered and returned to the line instead of being dissipated in the brakes. The Manchester car has now been on service for some months and the Glasgow car has run several special trials. Both have worked very satisfactorily, effecting appreciable savings in power consumption. A specially equipped car was paired with a standard car and the two worked together for definite periods on a number of routes. The results show that the regenerative tram on an 8.5 miles per hour service on a comparatively flat route took twenty-seven per cent less power than the standard tram.

#### Annual Symposium on Colloid Chemistry

THE tenth annual Symposium on Colloid Chemistry will be held in Ottawa, Canada, on June 16-18. About two hundred workers in this field of science are expected to attend the meeting, and Mr Emil Hatschek, lecturer on colloids at the Sir John Cass Technical Institute in London, will be the principal guest and speaker. He will read a technical

paper and will also give an evening lecture; the sessions will be held in the newly constructed National Research Laboratories. Papers will be presented on the colloid chemical aspects of such diverse subjects as the constitution of rubber, by Thomas Midgley, of Columbus, Ohio, diphtheria toxins and antitoxins, by P J Moloney, of the Connaught Laboratories, Toronto, asphalts by Charles Mack, of the Imperial Oil Company at Sarnia, studies in cellulose, by O Maass, of McGill University, Montreal, colloidal arsenic by E F Burton, of Toronto University, gelatin, by S E Sheppard, of the Eastman Kodak Company, Rochester, N Y, resins, by C H Winning, of the University of Wisconsin, Madison, cane wax in raw and refined sugar, by C F Bardorf, of the St Lawrence Sugar Refineries, Montreal.

#### Committee on Slaughter-house Methods and Equipment

THE British Science Guild has appointed a Committee on Slaughter-house Methods and Equipment, "To verify and tabulate information relating to methods of, and equipment for, the slaughtering of animals for food, with especial reference to sanitary, dietetic, and humane requirements, to investigate new methods and equipment, to convey information on the subject to local authorities and other bodies and persons." The Committee consists of Lieut-Col Sir Arnold Wilson (chairman), Capt C W Hume (vice-chairman), Mr John McMath (honorary secretary), and the following members appointed on the recommendation of the bodies indicated: Mr John Fearn (Institution of Mechanical Engineers), Dr Charles Porter (Society of Medical Officers of Health), Sir James Douglas and Mr R Stephen Ayling (Model Abattoir Society), Prof F T G Hobday and Lieut-Col T Dunlop Young (Royal College of Veterinary Surgeons), Mr J R Hayhurst (Royal Sanitary Institute), Lieut-Col T C R Moore and Mr R O P Paddison (Royal Society for the Prevention of Cruelty to Animals). The Medical Research Council has also been invited to recommend a member.

#### Birds in Inner London

A SHORT article in the May number of *British Birds* (p 355) reveals unexpected variety of bird life in the heart of a great city. The presence of gulls has become commonplace, and it is not surprising that birds on migration should be heard passing overhead, like the curlews mentioned. But the settling of exhausted landrails and a woodcock, the appearance of young cuckoos in several gardens, of wheatears in Regent's Park, of a black-necked grebe in Kensington Gardens, a cormorant on the cross of St Paul's Cathedral, and a pair of kestrels nesting in the belfry of St Paul's School, Hammersmith Road—these are things which must have surprised and delighted the fortunate observers.

#### Bureau of Contraceptive Advice

A STATISTICAL analysis by Prof Raymond Pearl on the year's operations of the Bureau for Contraceptive Advice, Baltimore, has been issued. During this, its



fourth year, 233 new cases attended the Bureau. All were married women, their average age was 30.44 years, and the average duration of marriage was 10.9 years—figures which refute some of the objections urged against contraception. Prof. Pearl considers that the Bureau has been in operation too short a time to make any definite report on the effectiveness of the advice given as to the technique of contraception.

#### Announcements

PROF. JACQUES HADAMARD (Paris), Prof. Graham Lusk (New York), Prof. Walther Nernst (Berlin), and Prof. Theobald Smith (Princeton) have been elected foreign members of the Royal Society.

M. LE DUC DE BROGLIE, who contributed to *NATURE* of May 7 the survey of Lord Rutherford's work which appeared in our series of "Scientific Worthies", has been elected an honorary member of the Cambridge Philosophical Society.

THE Council of the Chemical Society has awarded the Longstaff Medal for 1933 jointly to Prof. W. N. Haworth, of the University of Birmingham, and Sir James Irvine, of the University of St. Andrews, for their outstanding work on the chemistry of the sugars.

THE Joint Committee of the Royal Society of Edinburgh, the Royal Physical Society, and the Royal Scottish Geographical Society has awarded the Bruce Prize for the period 1930-32 to Mr. Herbert G. Watkins, for important contributions to the topography of Spitsbergen, Labrador, and East Greenland and investigation of the ice cap of Greenland. Mr. Watkins was leader of the Cambridge Expedition to Edge Island, Spitsbergen, 1927, leader of the Cambridge Expedition to Labrador, 1928-29, leader of the British Air Route Expedition to East Greenland, 1930-31, and will be leader of the projected expedition to Coats Land, 1932.

PROF. P. DEBYE, of Leipzig, has accepted the invitation of the Council of the Chemical Society to deliver the fifteenth Faraday Lecture on March 29, 1933.

SIR FREDERICK GOWLAND HOPKINS will open a discussion on "Recent Advances in the Study of Enzymes and their Action" to be held at the Royal Society on June 16. Other speakers will include Prof. R. Willstätter, of Munich, Prof. Waldschmidt-Leitz, of Prague, Dr. Richard Kuhn, of Heidelberg, Prof. A. Harden, Prof. J. B. S. Haldane, Dr. D. Keilm, and Dr. J. H. Quastel.

THE sixth Stephen Paget Memorial Lecture of the Research Defence Society will be delivered by Sir Arthur Keith at the annual general meeting of the Society to be held at the London School of Hygiene and Tropical Medicine on June 15 at 3 p.m. Sir Arthur will speak on "Some Aspects of the Modern Conflict between Reason and Sentiment."

MESSRS. Charles Baker, 244 High Holborn, London, W.C.1, have prepared a new issue (No. 101) of their classified list of second-hand scientific apparatus. Section I, dealing with microscopes and their accessories, is very full and covers a wide range of makes

and equipment. There is also an extensive section on surveying instruments, and others on astronomical and physical apparatus generally. Surveying instruments can be hired, and lantern exhibitions are arranged.

"La Maison de la Chimie" which is being erected in Paris will constitute an important centre of chemical activities. Apart from several meeting halls, the largest of which will accommodate a thousand people, it will contain an extensive library with special means of documentation, including films and discs, and the latest technical improvements. The building of this centre has been made possible by an international subscription on the occasion of the centenary of Marcelin Berthelot, and the gift by the French Government of the old palace de la Rochefoucauld d'Estissac, which is being reconstructed and extended to make it suitable for its new function.

WE have received from Messrs. British Drug Houses, Ltd., Graham Street, London, N.1, a copy of "B.D.H. Reagents for Delicate Analysis and Spot Tests", which contains descriptions of several new reagents for the detection of substances with minute amounts of material. Many of the reagents are specific, so that it is now frequently possible to avoid group separations. In each case references to the original literature are given, so that the information is useful as an addition to analytical chemistry. The price of the book, which is well bound, is 2s. 6d.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.—A woman lecturer in geography at Bingley Training College—The Education Officer, County Hall, Wakefield (June 15). A radium officer for a National Radium Regional Centre at Southampton—The Secretary, Royal South Hants and Southampton Hospital, Southampton (June 18). A head of the commerce department of the Gamble Institute, St. Helens—The Secretary for Education, Education Office, St. Helens (June 20). A laboratory assistant at the Joint Counties Mental Hospital, Carmarthen—The Clerk to the Visitors, 34 Quay Street, Carmarthen (June 20). An assistant lecturer in mathematics in the University of Sheffield—The Registrar, University, Sheffield (June 21). An assistant lecturer in geology in the University of Birmingham—The Secretary, University, Birmingham (June 23). An assistant lecturer in metallurgy and assaying at the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (June 30). A lecturer in mathematics in the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (July 2). A resident lecturer for biology and some mathematics at Stockwell Training College for Women—The Principal, Training College for Women, Stockwell, S.W.9. An assistant master, honours graduate in engineering, for the Day Technical and Commercial School, Westcliff-on-Sea—The Headmaster, Day Technical and Commercial School, Fairfax Drive, Westcliff-on-Sea.

ERRATUM.—*NATURE*, June 4, page 819, col. 2, lines 20-21, for *Pieris rapae* read *Pieris napi*.

## Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

### Photochemistry of Vitamins A, B, C, D

FROM their letter in NATURE<sup>1</sup> and various reports in the daily Press, it would appear that the work of Drs F P Bowden and C P Snow provides a new and powerful technique offering the prospect of an immediate extension of knowledge concerning vitamins. In scrutinising the evidence disclosed in favour of this claim, we find ourselves in difficulties. In the first place, the technique (the study of spectral absorption curves, and irradiation with light of selected wave-lengths) is familiar and has already been applied in vitamin studies, while in the second place, the idea of one experimental method as a key to several vitamins seems to underestimate the differences between organic compounds of widely varying constitution sharing only a capacity to induce unusual (but quite diverse) physiological responses. Drs Bowden and Snow evoke two possibilities

(1) The association of an absorption band with a vitamin on the basis of the disappearance of both activity and absorption as a result of irradiation with light of defined wave-lengths. Useful results on these lines have already been described for vitamin A in 1928.<sup>2</sup>

(2) That "When applied to a suitable pre-vitamin, monochromatic irradiation with light of the correct wave-length produces maximum yields of the vitamin." Apart from the ambiguous term "maximum yields", this statement is baldly true of existing knowledge concerning the ergosterol  $\rightarrow$  vitamin D transformation. The claim to have extended the idea of a photochemical precursor substance, by experiment, to other vitamins, is a recent departure first put forward by Rygh<sup>3</sup> in connexion with narcotine and vitamin C, and now again advanced by the authors in connexion with carotene and vitamin A. The work of Rygh has already been subjected to criticism,<sup>4</sup> and it is now necessary to consider the contribution of Drs Bowden and Snow. In the case of vitamin D, an association with photochemistry is of long standing (light therapy, especially in relation to rickets), but with vitamin A the association is exclusively with a metabolic rather than a photochemical pre-vitamin. Having observed the presence in  $\beta$ -carotene of a band at 270 m $\mu$  (this band has previously been recorded),<sup>5</sup> the authors subjected a solution of  $\beta$ -carotene in cyclohexane to monochromatic irradiation (Hg 265 m $\mu$ , 253.7 m $\mu$ ) in an atmosphere of nitrogen. After a few hours a strong band appeared near 328 m $\mu$  and the resultant product was found to give a blue colour with antimony trichloride. From these results, pending biological experiments, a photochemical transformation of carotene into vitamin A is claimed.

Now, whereas the vitamin A of liver fat is a practically colourless alcohol (most probably C<sub>20</sub>H<sub>30</sub>O  $\overline{\text{F}}$ )<sup>6</sup> exhibiting near 328 m $\mu$  a band of defined intensity ( $E_{1\text{ cm}}^{1\text{ per cent}}$  1350) and giving a blue colour with antimony trichloride sharply differentiated ( $\lambda_{\text{max}}$  617 m $\mu$ ) from the blue colour given by carotene ( $\lambda_{\text{max}}$  585-590 m $\mu$ ),<sup>7</sup> the experiment of Bowden and Snow, properly executed, can only yield hydrocarbons. From the published spectrograms their product is obviously

coloured and in all probability contains unchanged carotene, so that the relevance of the promised biological assay does not emerge, since it has been fully established<sup>8</sup> that carotene is converted *in vivo* into vitamin A.

The one piece of concrete evidence is the recognition of a new maximum near 328 m $\mu$ . In this instance the authors are using the band as a criterion for a complex molecule, but elsewhere in their communication they refer to the diagnosis of absorbing groups. At the best, they have evidence of a product possessing a molecular grouping similar to that present in vitamin A, but they omit to deal with the obvious and more probable explanation, namely, a molecular rearrangement. Actually, we have observed here that *iso*-carotene,<sup>9</sup> which is a coloured substance readily obtained from carotene in various ways, also possesses a sharp band near 320 m $\mu$ . The destruction of vitamin A by radiation within the 328 m $\mu$  band has already been fully demonstrated.<sup>9</sup>

*Vitamin B.*—The fact that a crystalline specimen of this vitamin exhibits absorption maxima at 260, 240, and 210 m $\mu$  is an interesting qualitative observation, the value of which for the diagnosis of structure remains to be demonstrated. For purposes of assay, the observation only becomes useful if it can be shown that the materials normally accompanying the vitamin are themselves much more transparent in the region 200-270 m $\mu$ . That irradiation (Hg 253.7 m $\mu$ ) destroys the vitamin and effects the disappearance of the 260 m $\mu$  band is in no sense surprising. If the material were pure, then obviously the other bands must equally be properties of the vitamin, and hence the claim that the physiological activity arises in some special sense from the part of the molecule giving rise to the 260 m $\mu$  band, far from being "fully established", is unjustified. Until the structure of the organic molecule is at least broadly established, this kind of interpretation of spectral absorption data is both uninformative and premature.

*Vitamin C.*—Drs Bowden and Snow state that when they are able to record the absorption spectrum of pure vitamin C, they will be able to test its identity with either irradiated narcotine or hexuronic acid. This is so true as to be obvious, but the necessity for monochromatic irradiation does not emerge.

*Vitamin D.*—Here Drs Bowden and Snow appear merely to have confirmed earlier observations, except as regards the sentence "the spectroscopic evidence is, however, already sufficient to indicate that the conversion of ergosterol into calciferol depends on the migration of a double bond to a position in which its influence on the other double bonds is greatly enhanced" (our italics). We would inquire what the authors intend to convey by the italicised phrase. So far as the known absorption spectra of calciferol and ergosterol are concerned, the statement conveys no meaning whatever. No indication is given of any other criteria of 'enhanced influence', neither is it clear what is meant by the *elimination* of an absorbing group from a complex organic molecule by irradiation with light of related frequency. Before such considerations can be of much avail, it is essential to know exactly the nature of the absorbing group—and in most complex organic compounds, the present position of the interpretation of absorption spectra does not make this possible. In this connexion neither the origin of the ergosterol bands nor the calciferol band is yet understood. The possibility of a rearrangement of the double bonds of ergosterol has already been fully studied by Windaus<sup>10</sup> by strictly chemical methods.

In the case of vitamin A, the effective entity is possibly a system of four conjugated double bonds. We can understand a photochemical process breaking

up this system, but eliminating the group with "ease and certainty" has no precise meaning

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May 26

- <sup>1</sup> Bowden and Snow, *NATURE*, 129, 720, May 14, 1932  
<sup>2</sup> Morton and Heilbron, *Biochem J.*, 22, 987, 1928  
<sup>3</sup> Rygh and Rygh, *Z. physiol. Chem.*, 204, 114, 1932  
<sup>4</sup> Zulva, *J. Soc. Chem. Ind.*, 51, 166, 1932  
<sup>5</sup> Dulière, Morton, and Drummond, *J. Soc. Chem. Ind.*, 48, 316T, 1928  
<sup>6</sup> Karrer, Morf, and Schopp, *Helv. Chim. Acta*, 14, 1036, 1931, and *Helv. Chim. Acta*, 14, 1431, 1931  
<sup>7</sup> Heilbron, Heslop, Morton, Drummond, and Rea, *J. Soc. Chem. Ind.*, 51, 164, 1932  
<sup>8</sup> Moore, *Biochem J.*, 23, 803, 1929  
<sup>9</sup> Gillam, Morton, Heilbron, and Drummond, *J. Soc. Chem. Ind.*, 51, 164, 1932  
<sup>10</sup> Windaus, *Proc. Roy. Soc. B*, 108, 568, 1931

### Resistance of the Eggs of Collembola to Drought Conditions

THE activity and abundance of Collembola are closely associated with the moisture of their environment. The species *Sminthurus viridis* (L.) Lubbock occurs in large numbers in certain areas of South Australia during the rainy season (May to October). The numbers rapidly decrease when the dry season sets in and, normally, the insect does not occur again until about the following May.

Certain of the eggs remain dormant in the soil during the dry season. This condition is not due to a definite rhythmical diapause, but is enforced owing to the lack of moisture in the surface soil during this

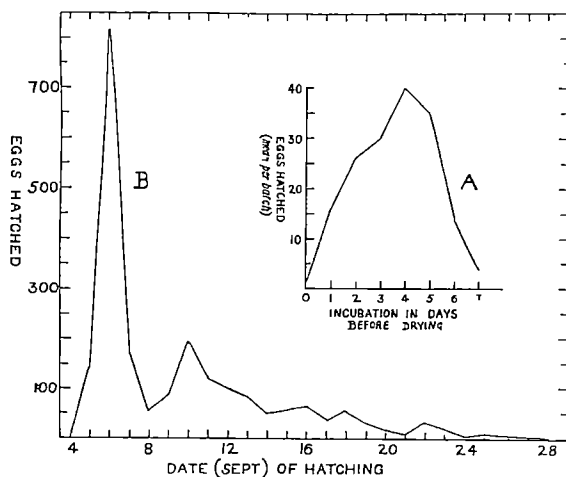


FIG 1

season. The eggs can be induced to hatch with suitable moisture and temperature.

During experimental work with this species, it was found that with egg batches, exposed to dry conditions for varying periods and then remoistened, the eggs commenced to hatch in a comparatively short time, showing that some development had taken place prior to being remoistened.

The stage of development attained by the eggs prior to the onset of dry conditions is an important factor affecting the number which survive a temporary drought period. 100 egg batches of *S. viridis*, estimated at 4500 eggs, were arranged in eight series (Series 7 to 0). The number of batches in each series was 18, 13, 14, 13, 14, 9, 8, 11. The batches were laid on moist soil contained in 2½-in. flower pots, the conditions being uniform. There were six pots in

each series, and the batches were retained, as laid, *in situ* on the soil, throughout the experiment.

With Series 7, the pots were placed in an incubator at 24° C for 7 days from the date of being laid, the soil being kept suitably moist. With Series 6, the pots were 6 days in the incubator, and so on, with the remaining series to Series 0 with no days in the incubator. All the pots were then transferred to a heated glass-house on the same day (Aug. 15) and the soil allowed to dry out for 17 days. (Mean daily max temp 30° C, min temp 12° C. Mean daily relative humidity 56 per cent.) By Aug. 17 the moisture content of the surface soil, based on the moist soil, was 2.5 per cent. On Sept. 1, the soil in all the pots was remoistened and the daily hatching from each series was recorded. (During the period, Sept. 1–16, the mean daily max temp was 28° C, and mean min temp 11° C.)

A total of 2144 eggs hatched. The mean number of eggs per batch which hatched in each series is shown in Fig. 1, A, and the daily total of eggs which hatched from all the series is shown in Fig. 1, B. (In Series 7, 93 eggs hatched during Aug. 17–20. In Series 6, 86 eggs hatched during Aug. 18–20. These are not included.) I have discussed the normal incubation period elsewhere.<sup>1</sup>

The relative resistance of the egg at different stages appears to be associated with the changes occurring during development. In the advanced stages of the embryo, the egg swells and the chorion splits at the equator. Two polar caps are thus formed which gradually separate, revealing the embryo surrounded by a transparent membranous envelope.

Ripper<sup>2</sup> has described changes in the egg of *Hypogastrura* in this respect, which differ in detail from that of *S. viridis*.

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March 31

<sup>1</sup> *Australian J. Expt. Biol. and Med. Science*, 8, 143, 1931

<sup>2</sup> *Z. angew. Entom.*, 16, 559, 1930

### Inheritance of Milking Capacity

IN replying to Mr. Buchanan Smith's remarks<sup>1</sup> concerning my discussion<sup>2</sup> of Mr. Madsen's letter,<sup>3</sup> I shall deal with them in the order set out by him.

(1) I suggested that the small correlation to the paternal granddam might be explained by the selection of the sires of bulls studied as prepotent on the basis of the progeny test (rather than on their dams' records), a form of reasoning used by Mr. Buchanan Smith for another purpose<sup>4</sup> in discussing a low correlation of daughters' yields to their paternal granddams' yields when he states "this may probably be explained by the fact that up till quite recently in the Ayrshire breed the bull was selected not on the performance of his dam so much as on the show-yard record of his sire." In each case the principle is obviously the same—the bull being selected with little reference to his dam's record. Mr. Buchanan Smith's statement that "when the full paper is published Mr. Madsen will show that the majority of sires involved have not been selected on genotype but on appearance plus pedigree" is difficult to reconcile with Mr. Madsen's own statement about "breeders who for the past 15 years have, through an intelligent appreciation of the progeny test, paid almost exclusive attention to the male line."

(2) Rather than to the contrary we find ourselves in agreement on the second point, I stated that a cow's record is insufficient in foretelling the production

of her progeny because it is the expression of a phenotype and Mr Buchanan Smith allows that rarely is the cow's genotype capable of assessment because of the small numbers of her progeny. This is a state of affairs in no way improved upon by any increase in the number of daughter-dam pairs, and as in discerning inheritance it is essential to distinguish transmitting ability from actual production, it is difficult to see why two small correlations to phenotypes far removed can be expected to reveal anything. Actually the correlations amongst genotypes in Mr Madsen's data should more reasonably be expected to yield a clue, as the X-chromosome which the bulls receive comes as often from the maternal grandsire as from the maternal granddam, though never from the paternal grandsire. Mr Madsen finds that to the latter parent  $r = 0.202$ , while to the maternal grandsire  $r = 0.194$ , which would indicate that the presence or absence of the X-chromosome makes no difference.

The method of direct correlation employed leaves much to be desired. To a daughter's inheritance the sire and dam each contribute and yet in the daughter-dam correlations the sire's part is completely left out of account. This omission is not made good by an increase in the number of daughter-dam pairs studied.

(3) and (4) That the suggestion of inaccuracy in the calculation of the odds as one in ten is unfortunate is shown by Dr J Wishart in a letter contributed below.

I agree with Mr Buchanan Smith that Mr Madsen's investigation is particularly exhaustive and it is the very thoroughness with which he has prosecuted it which makes the likelihood of significant sex-linkage even more uncertain.

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<sup>1</sup> NATURE, 129, 688, May 7, 1932.

<sup>2</sup> NATURE, 129, 437, March 19, 1932.

<sup>3</sup> NATURE, 129, 165, Jan 30, 1932.

<sup>4</sup> Smith, A. D. Buchanan, and Robison, O. J., "The Inheritance of Milk Yield." Conference Papers, Internat. Dairy Cong., Copenhagen, 1st section, pp. 127-140, 1931.

THE standard errors of the correlation coefficients 0.026 from 721 pairs and 0.112 from 715 pairs are almost exactly equal, at 0.037. Thus the difference 0.086 is 1.64 times its standard error, and treating this as a normal deviate it appears that a difference of this size, or greater, would occur in random samples from equally correlated populations just once in ten times on the average. Mr Edwards used the more exact  $z$ -transformation of R. A. Fisher, but the small size of the correlations and the large numbers on which they are based, lead to exactly the same result by both methods. The observed coefficients are thus compatible with the hypothesis that the correlations with paternal and maternal granddam are equal. The best value for the joint correlation afforded by the data is 0.07, so that the relationship at best is very slight.

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#### Light and Sexual Periodicity

IN the North Greenland (Peary) Expedition, evidence of sexual periodicity in the Eskimos was observed by Cook.<sup>1</sup> Thus, with the onset of the sunless winter, sexual desire fails and menstruation during the long period of darkness is absent. But with the dawn of spring a phase of sexual excitement or pro-oestrus ensues, menstruation returns, and the majority

of the children are born nine months after the return of the 'sun'. The girls marry at fourteen or fifteen years of age, but the menstrual flow does not begin until they are nineteen or twenty years old. Children are 'suckled' for four to six years, and on the average one child is born every four years. Stieve and others, too, have noted that in the long polar night Eskimo women neither menstruate nor conceive. If this hiatus in the sexual cycle be due to absence of light, it must be of 'sunlight', for moonlight is present in the polar night. Light and heat rays seem essential for maintenance of the sexual cycle.

This annual recurrence of a 'menopause' suggests a species of 'hibernation' localised to the hypophysio-gonadal system, and that it should be so restricted and not generalised is presumably due to the fact that they—unlike warm-blooded hibernants—have no 'fat gland' to draw upon during the long winter sleep. Hence the need of fat consumption, and body temperature stabilisation forbids such marked slowing down of tissue metabolism, pulse, and respiration—with consequent induction of sleep, oliguria, and poikilothermia—as occurs in true hibernants which pass the winter in a state of retarded animation.

This assumption of localised hibernation of the hypophysio-gonadal system recalls the many similarities obtaining between generalised hibernation and pituitary (anterior hypophysis) dysfunction. In hyper-pituitarism (acromegaly) sexual desire is increased, but in hypo-pituitarism abolished—males become impotent, and in females menstruation ceases. This correlated variation of pituitary (hypophysial) with gonadal functional activity indicates that the sexual cycle is controlled by the hypophysis and any interruption in sexual rhythm—apart from local causes—referable thereto. Hence, may not the recurring seasonal loss of sexual desire, with impotence in males and absence of menstruation in females, be due to seasonal suppression of the functional activity of the hypophysis (hypo-pituitarism) with its correlated cessation of gonadal activity—the same referable to lack of the stimulus 'sunlight'?

Alike in Eskimos and hibernants, for example, bear and sloth, the 'awakening' in spring—almost certainly due to resumption of hypophysial activity—signals the onset of the 'mating' or 'rutting' season. Further resemblances between hibernation and hypo-pituitarism are that in both states the basal metabolic rate and body temperature are lowered. Again, in both sexes in hypo-pituitarism 'adiposity' ensues, which possibly acts vicariously as a substitute for the 'fat gland' of hibernants. With these changes, too, are associated lethargy, slow pulse, and a moderate degree of somnolence. The parallel, then, between states of hibernation and hypo-pituitarism is suggestively close—the differences being quantitative rather than qualitative.

It has been suggested that the sexual periodicity in Eskimos is a racial peculiarity. But Cook—in alluding to the suppression of sexual desire and menstruation with "great muscular debility" in Eskimos—observes, "Our own party suffered in the same way." Their participation would seem to rule out any question of its being a racial peculiarity, indicating rather that all persons, when living in the arctic zone, react in like fashion to long-continued absence of 'sunlight'. As to the pathway of light transmission, that of vision first presents itself, and possibly light mediated through the hypophysis in this way influences the sex organs.

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<sup>1</sup> F. Cook, *New York Journal of Gynecology and Obstetrics*, 1894.

Chromatid Segregation in Tetraploid *Rubus*

IN *Rubus rusticanus* an unprickled variety *inermis* occurs. The character behaves as a recessive in reciprocal crosses with the normal type. In 1927,<sup>1</sup> we showed how this character was inherited in tetraploid forms. A tetraploid seedling 'RT4' was raised from the cross *R. rusticanus inermis* ♀ ( $n=7$ ) by the tetraploid prickled species *R. thyrsiger* ♂ ( $n=14$ ), the female parent had given an unreduced egg with 14 chromosomes, which was fertilised by normal pollen of *R. thyrsiger*, also with 14 chromosomes. The constitution of RT4 in regard to the *inermis* character was, therefore, *AAaa*. With random segregation amongst four chromosomes (considered by Muller in 1915) it should have given a 35:1 ratio of prickled to unprickled. With regular segregation of *A* from *a* (allosyndesis) it should have given a 15:1 ratio. The proportion found was intermediate (471:19) and we considered therefore that randomness was modified in the direction of allosyndesis—an improbable but, as it then seemed, an inevitable explanation.

Haldane<sup>2</sup> has applied the principle of chromatid segregation to polyploids. This principle was first demonstrated in polyploid *Drosophila* and agrees with the simplified chiasmotype hypothesis of crossing-over. The ratios expected with random chromatid segregation in a tetraploid of the constitution *AAaa* are 20:78:1 (187:9) instead of 35:1, and in the backcross to *aaaa* 3:67:1 (11:3) instead of 5:1. The following table shows the comparison of new results obtained in the last five years with the two alternative expectations of random segregation of chromosomes and chromatids. (The possibility of allosyndesis need not now be considered.) The results agree closely with the chromatid expectation and differ significantly from the simple chromosome expectation.

|                                                 | Prickles     | No Prickles |
|-------------------------------------------------|--------------|-------------|
| <b>Selfed (<i>AAaa</i> × <i>AAaa</i>)</b>       |              |             |
| Observed (872 plants)                           | 835          | 37          |
| Chromatid expectation                           | 832.0 ± 6.2* | 40 ± 6.2    |
| Chromosome expectation                          | 847.8 ± 4.9  | 24.2 ± 4.9  |
| <b>Back-crossed (<i>AAaa</i> × <i>aaaa</i>)</b> |              |             |
| Observed (43 plants)                            | 33           | 10          |
| Chromatid expectation                           | 33.8 ± 2.7   | 9.2 ± 2.7   |
| Chromosome expectation                          | 35.8 ± 2.4   | 7.2 ± 2.4   |

\* Standard error,  $\sigma = \sqrt{p(1-p)/n}$

Blakeslee and his collaborators<sup>3</sup> have found recessives in the progeny of *AAAA* plants of tetraploid *Datura*, and *AAaa* plants also show ratios that may be accounted for by chromatid segregation. These are the only sharp deviations from the simple chromosome segregation yet observed in autotetraploids. The explanation is clear. Chromatids from the same parental chromosome have been shown to segregate together at the spindle attachment, both where chromatid segregation has been shown genetically<sup>4</sup> and where crossing-over has been proved cytologically.<sup>5</sup> Random chromatid segregation will therefore only be expected with factors having 50 per cent of observed crossing-over between them and the spindle attachment, a value which under most conditions is only approached asymptotically.

Observations of inheritance in tetraploids therefore confirm expectation based on general cytological and genetical observation, and particularly agree with the chiasmotype hypothesis of crossing-over.

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John Innes Horticultural Institution,  
London, S W 19, April 28

<sup>1</sup> *Genetica*, 9

<sup>2</sup> *J. Genet.*, 22, 1931

<sup>3</sup> *Bot. Gaz.*, 76, 1923

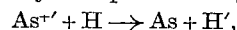
<sup>4</sup> E. G. Anderson, *Genetics*, 10, 1925

<sup>5</sup> Darlington, *Proc. Roy. Soc., B*, 107, 1930 *J. Genet.*, 24, 1931

## Resonance Spectrum of Hydrogen

It was reported in a previous communication<sup>1</sup> that, in the course of experiments by Dr J. S. Badami and me on the spectrum of arsenic by the Paschen hollow cathode discharge in helium, the Lyman series of hydrogen was obtained with remarkable strength, the important feature of the series being the curious intensity anomaly exhibited by the members. Instead of the intensity gradually falling off, a sudden enhancement was observed in that of the 10th and the 11th members ( $\nu 108,771$  and  $108,916$ ). Experiments under varying conditions indicated definitely that this intensity anomaly occurs only in the presence of arsenic. The suggestion was made that the energy of excitation of this resonance spectrum is to be sought for in a transfer, by collisions of the second kind, from the excited arsenic atoms. Since sending this report, values of the characteristic energy levels of the neutral and ionised atom of arsenic<sup>2</sup> have become available, and a consideration of these has confirmed the above explanation.

The reaction may be represented by the equation



where  $\text{As}^{+'}$  represents an arsenic ion in an excited metastable state. The existence of such states, formed by collisions of the second kind with excited rare gas atoms or ions, in the source employed, can be easily supposed from the experiments of various investigators on this method of discharge. The excitation energy of the enhanced 11th member of the hydrogen series is 13.44 volts, and the energy corresponding to a transition of the excited arsenic ion in the metastable state  $4p\ ^1S_0$  to the normal state  $4p\ ^4S_2$  of the neutral atom (that is,  $\text{As}^{+'} \rightarrow \text{As}$ ) is found equal to the above value within the limits of error involved in the estimate of the first ionisation potential of arsenic.

The phenomenon appears to be analogous to the observations made by Beutler and Josephy,<sup>3</sup> where a mixture of the vapours of sodium and mercury and a foreign gas was excited by mercury radiation  $\lambda 2537$ , and the lines  $2P - 5S$  and  $2P - 7S$  of sodium appeared with great intensity, the excitation energy of these lines corresponding closely to the energy of the excited states  $2\ ^3P_1$  and  $2\ ^3P_0$  of mercury. It is to be noticed that a close 'resonance' between the two colliding partners is of importance for this transfer of energy.

If the above interpretation of the phenomenon is accepted, we meet here with a type of collision which, so far as I am aware, has not hitherto been observed. We have evidence<sup>4</sup> of a simultaneous ionisation and excitation by collisions of the second kind with excited atoms, in which the reaction can be represented by the equation  $A + B' \rightarrow A^{+'} + B$ . The present phenomenon represents then a type of impact in which, clearly, the reverse process is involved.

A full report of the experiments will be published shortly.

K. R. RAO

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Kodaikanal, S. India, April 8

<sup>1</sup> *NATURE*, 123, 585, Oct 3, 1931

<sup>2</sup> A. S. Rao *Proc. Phys. Soc.* (in the course of publication), As II ( $4p\ ^3P_0 - ^3P_2 = 2540$ ,  $4p\ ^1S_0 - ^1D_2 = 12,504$ ,  $4p\ ^1D_2 - ^3P_2 = 7555$ ), (unpublished results) As I ( $4p\ ^4S_2 = 85,000$ )

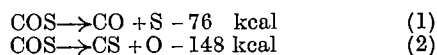
<sup>3</sup> Beutler and Josephy, *Naturwiss.*, 15, 540, 1927

<sup>4</sup> Duffendack and Smith, *Phys. Rev.*, 34, 68, 1929

## Photochemical Dissociation of Carbonyl Sulphide

WE have recently determined the ultra-violet absorption spectrum of carefully purified carbonyl sulphide, using a quartz spectrograph and a hydrogen discharge tube as a source of light. The spectrum shows a continuous absorption starting from a sharp limit at  $\lambda = 2550 \pm 20$  Å and extending far towards the ultra-

violet This spectrum is interpreted as corresponding to the dissociation of the COS molecule, which was also indicated by the deposit of sulphur on the walls of the absorption tube The products of dissociation may be CO and S, or CS and O The energies of these processes as calculated from thermochemical data are



The determined photochemical dissociation energy is 4.84 volts or  $111 \pm 1$  kcal and hence the dissociation must proceed according to (1) The difference between the observed and calculated dissociation energy is 35 kcal and corresponds to the excitation energy of the sulphur atom, since the first excitation potential of the carbon monoxide molecule, as obtained from band spectra analysis, is 5.9 volts above the ground-level The energy of 1.5 volts (35 kcal) corresponds to the difference in energy between the  $3p$  ground-level and the  $1d$  metastable state, as the lowest possible excitation energy of the sulphur atom The position of the latter term has not yet been established directly Christy and Naudé<sup>1</sup> have recently suggested 1.6 volts from a study of the predissociation spectrum of the sulphur molecule This is in excellent agreement with the above value

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<sup>1</sup> Christy and Naudé, *Phys Rev*, **37**, 907, 1931

#### Rotation of Molecules in Crystals

AN investigation on the relation between the crystal structure and optical properties of organic crystals has revealed further cases of 'rotating' and 'fixed' molecule forms in aliphatic compounds A hexagonal rotating form has been observed between  $16^\circ$  and  $24^\circ \text{C}$  in dodecyl alcohol  $\text{C}_{12}\text{H}_{25}\text{OH}$  The distance between chains is 4.76 Å, corresponding to the 4.85 Å found by A. Muller<sup>1</sup> for paraffins The low temperature form, however, differs by being monoclinic with inclined chains corresponding to the high temperature form of the monobasic acids The transitions between these forms could be followed for single crystals in the polarising microscope

A non-rotating form of alkyl-ammoniohalide has been found for  $\text{C}_{18}\text{H}_{37}\text{NH}_3\text{Cl}$  It is orthorhombic with a base  $5.2 \text{ Å} \times 5.15 \text{ Å}$  as against  $5.02 \text{ Å}$  for the tetragonal 'rotating' lower members studied by S. P. Hendricks and others,<sup>2</sup> but with the hitherto unobserved feature of four layers per cell in alternate pairs inclined approximately  $48^\circ$  to the  $c$  plane This leads to a negative birefringence unlike that of all other long chain compounds

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<sup>1</sup> NATURE, **129**, 436, March 19, 1932

<sup>2</sup> *Ibid* **128**, 410, 1931

#### Heat of Dissociation of Nitrogen

THE value of the heat of dissociation of nitrogen has formed a lively subject of controversy in the past few years All values from 19 to 7 volts have been given by various workers for the dissociation potential I have recently determined this value by examining the absorption spectrum of  $\text{N}_2\text{O}$  in a manner which has already been explained in my note on the spectrum

of  $\text{SO}_2$ .<sup>1</sup> The value comes out to be 8.8 volts or 203 kcal

The absorption spectrum of  $\text{N}_2\text{O}$  is perfectly continuous, with no trace of bands, as in most saturated compounds From microphotometrical study of the absorption spectra taken at different pressures, I found that the absorption begins at  $\lambda 2740$ , corresponding to 104.4 kcal Assuming that this corresponds to a photochemical breaking up of  $\text{N}_2\text{O}$  into NO and N (this assumption is supported by other arguments), and utilising other thermochemical data, the heat of dissociation comes out as 203 kcal This value is in good agreement with the most recent results of Turner and Samson,<sup>2</sup> and Tate and Lozier,<sup>3</sup> obtained by other methods, and is certainly the most accurate value of the heat of dissociation of  $\text{N}_2$  obtained so far

ARUN K DATTA

Department of Physics,  
Allahabad University,  
March 31

<sup>1</sup> Datta, NATURE, **129**, 317, Feb 27, 1932

<sup>2</sup> Turner and Samson, *Phys Rev*, **34**, 747, 1929

<sup>3</sup> Tate and Lozier, *Phys Rev*, **39**, 254, 1932

#### Decomposition of Hydrogen Peroxide by Catalase

IN his recent statistical calculations on the decomposition of hydrogen peroxide by catalase, Prof J. B. S. Haldane estimated<sup>1</sup> that the mean life of an active catalase-hydrogen peroxide molecule is about  $10^{-7}$  second, and the velocity constant for the union of catalase and hydrogen peroxide exceeds  $7 \times 10^8$

Work at present in progress, consisting of a comparison of the photochemical decomposition with the enzyme reaction, indicates that the latter may have to be regarded as a *chain reaction*, in which the active centres of the enzyme function only by starting the chains, which then continue in the bulk of the solution, or on other surfaces

This view becomes more credible in the light of recent work by Allmand and Style, who conclude that even in dilute aqueous solutions of hydrogen peroxide "the photochemical, and hence presumably the thermal reaction, is a chain reaction", and "the reaction chains must be exceedingly long—of the order of  $10^4$  to  $10^7$  links"

According to this view, the inhibition of enzyme reactions may be due in some cases to the breaking of the reaction chains by the inhibitors, as in numerous photochemical reactions.

Zeile and Hellstrom have shown that iron-porphyrin compounds form the active centres in catalase, and, in 1931, I observed that the action of iron compounds in certain inorganic systems analogous to enzyme systems can best be explained by the chain-reaction hypothesis,<sup>2</sup> a view which was put forward independently by Prof. Haber a few weeks later<sup>4</sup>

I conclude that in view of these facts a modification may have to be introduced into Prof. Haldane's interesting calculations on catalase

DEREK RICHTER

Dyson-Perrins Laboratory,  
Oxford, May 12

<sup>1</sup> *Proc Roy Soc*, B, **108**, 559, 1931

<sup>2</sup> *J C S*, 621, 1930

<sup>3</sup> *Ber*, **64**, 1240, 1931

<sup>4</sup> *Naturwiss*, **22**, 450

#### Electrochemical Periodicities

THE interesting observation of periodicity at a platinum anode in a solution of dilute sulphuric acid containing dissolved hydrogen, recently reported by Butler and Armstrong,<sup>1</sup> recalls an unpublished experiment which I made in 1927 during the course of a series of investigations of this subject



I found that when copper was made the cathode in 10 per cent nitric acid at low current densities (about 5 ma per sq cm), its potential oscillated continuously in periods having a duration of about 1 second and an amplitude of about 0.1 volt. No gas was evolved. This case is complementary to that reported by Butler and Armstrong, for, whilst their observations refer to an anodic process in a reducing solution, mine are concerned with a cathodic process in an oxidising solution. I assumed the periods to be connected with the formation of reduction products of nitric acid—probably ammonia.

Regarding the cause of the periodicity, my experiments on anodic reactions (described fully in "Protective Films on Metals" London Chapman and Hall) showed that the phenomenon appears when the electrode has almost equal chances of being 'passive' or 'active', or, in general, of being coated or not with a more or less protective film. The phenomenon also appears at the cathode when two reactions are equally probable, and all the evidence points to a critical concentration of ions which must be attained in order to effect the change from one state to the other, a fresh period begins each time the critical concentration is reached by diffusion.

The existence of periods at both anodes and cathodes may be expected by analogy, therefore, when the oxidising or reducing tendency of the electrode is approximately equal to the reducing or oxidising power of the solution. Two years ago I commenced preliminary experiments with the intention of leading to a general study of the cathodic reduction of oxidising solutions and the anodic oxidation of reducing solutions from this point of view, but the work had to be discontinued.

ERNEST S. HEDGES.

Carfax, Urmston,  
Manchester

<sup>1</sup> NATURE, 129, 613, April 23, 1932

#### Dependence of Angle of Contact on the Constitution of Adsorbed Organic Compounds

IN the course of an investigation conducted on behalf of the Broken Hill South, North Broken Hill, Zinc Corporation, Electrolytic Zinc, Mount Lyell, and Burma Corporation Mining Companies, measurements were made by two of us of the effect of xanthates on the angle of contact at a line of triple contact, mineral-water-air. These have been reported in Technical Publication No. 461 of the American Institute of Mining and Metallurgical Engineers. A trace of potassium ethyl xanthate, dissolved in the water, leads to an angle of contact which is independent both of the concentration of the xanthate and the nature of the mineral. Another compound containing the ethyl group, sodium di-ethyl dithiophosphate, leads to an identical angle of contact. At the time of publication of the above paper it was uncertain whether this was merely a coincidence.

Under an arrangement with the University of Melbourne, the measurements have now been extended by the third author (E. E. W.) to include several other organic types. It has been proved that several ethyl derivatives containing the -SH group lead to this same angle of contact ( $60^\circ \pm 2^\circ$ ). Moreover, each alkyl or aryl group exhibits a characteristic angle of contact, which apparently is independent of the nature of the polar group of the adsorbed molecule.

During the course of this work the contact angles at the surfaces of a large number of minerals and metals have been investigated.

It is inferred that the mineral or metal surface is covered by a unimolecular film of the thio-compound, in which the alkyl group is oriented outwards, and

that the alkyl groups are packed as closely as their size will permit.

Details of the investigation will be published elsewhere.

A. B. COX

ELSIE E. WARK

I. W. WARK

Department of Chemistry,  
University of Melbourne, March 11

#### Rediscovery of *Caloprymnus campestris* (Marsupialia)

SINCE Sir George Grey sent the three original specimens to the British Museum, in 1843, this interesting marsupial, one of the 'Rat-Kangaroos' of the subfamily Potorominae, has been completely lost to science. There is a somewhat doubtful record of it in 1878, but no specimen of the animal exists in any museum in Australia, and there was much to justify the generally accepted view that the animal was extinct.

Following the preliminary announcement by me in September last<sup>1</sup> that *Caloprymnus* was still extant, field work was undertaken in the locality of the first occurrence, with considerable success. The animal has now been shown to have a wide but sporadic distribution in the great area of sandhill and gibber plain country enclosed by the Diamantina and Cooper Rivers between latitudes  $24^\circ$  and  $29^\circ$  south (approximately).

Evidence obtained indicates that *Caloprymnus* has had a long and probably uninterrupted tenure of the area, but that normally its occurrence is very sparse. The passing of drought conditions has apparently provided a stimulus, resulting in a considerable local increase in its numbers.

A series of specimens in several developmental stages was secured, and a restatement of the characters of the animal and of its habits and economy is being prepared. The locality from which Sir George Grey's specimens come is uncertain. Any information on this and allied points, by students in England who have had access to Grey's papers, especially his correspondence with Gould, would be welcomed by me.

H. H. FINLAYSON

The University, Adelaide,  
April 12

<sup>1</sup> *Trans. Roy. Soc. S. Aust.*, 55, p. 162

#### Heterospory and the Angiosperms

PROF. RUGGLES GATES in his interesting letter on this subject<sup>1</sup> compares the size of the microspore and megaspore *mother-cells* in Angiosperms, and finds that the former are in some cases larger than the latter. But is the size of the *mother-cells* material to the question? Surely it is the relative volume of the mature and functional microspores and megaspores which determines heterospory. In the heterosporous Pteridophytes there may be little or no difference in the size of the respective *mother-cells* up to the time of their division.

As a palaeobotanist, I have no prejudice in favour of the origin of the flowering plants from heterosporous Cryptogams. The fossil evidence so far lends no support to this classical hypothesis. But it does seem to me that the existing Angiosperms (and Gymnosperms also) do, as a matter of fact, show in general a marked heterosporous differentiation, if one compares their pollen grains and embryo sacs when functionally mature.

D. H. SCOTT

East Oakley House,  
Basingstoke, May 31

<sup>1</sup> NATURE, 129, 793, May 28, 1932

## Research Items

**Bride Wealth among the Hehe, Tanganyika Territory**—In *Africa* (vol 5, No 2) for April, Mr G. Gordon Brown analyses the custom of the bride-price, or bride wealth as he prefers to call it, with reference to its several functions in relation to the observances connected with marriage. The primary function of *mafungu* is to stabilise marriage. Its amount is one of the essential matters settled at the betrothal ceremony, when relatives of both families are present. The last word lies with the father of the bride, who first names the amount and may or may not agree to any change afterwards suggested by the relatives on his side. The groom does not pay the amount out of his own wealth, but is assisted by his kinsmen, the father or father's family usually supplying two-thirds of the amount, and his mother or mother's family one-third. It is supposed to be paid to the bride's father on the day of the wedding. He keeps two-thirds and gives one-third to the bride's mother. Until the *mafungu* is paid, the marriage is not considered to be binding. Its payment is, in fact, necessary to legalise the marriage. Unless it has been paid, a husband cannot sue for adultery compensation. In case of divorce, the *mafungu* must be returned. The interest of the family in the *mafungu*, their co-operation in raising it, and the difficulties of collecting it when returnable on dissolution of the marriage, give the families an interest in maintaining the marriage and endeavouring to avert a possible divorce. In certain cases, such as cross-cousin marriage, the *mafungu* is less, as the bond of kinship makes it unnecessary to require so large an amount to secure the desired stability.

**Warfare in Eddystone Island**—Mr A. M. Hocart has described (*J. Roy. Anthropol. Inst.*, 61, pt 2) the methods of warfare of the inhabitants of Eddystone of the Solomons. The natives still go armed, although the spear and shield are not now carried, but a man will scarcely abandon his tomahawk, which is, besides, a handy tool for husking coco-nuts and cutting branches. It has displaced the original weapon, a paddle-shaped club. Warfare may be divided into wars of revenge and head hunts. The two chief causes of internal strife are murder and adultery. Heads are not caught at random, but for the definite purpose of inauguration, the term used in the vernacular meaning 'to moisten' or 'to wet', presumably with blood, the occasion being the inauguration of new canoes, new communal houses, new skull houses, the death of a chief, and the release from confinement of a widow. Ysabel became the favourite hunting ground for the people of Eddystone. Turtle expeditions were often pretexts for head hunts. Slaves were also captured, but when captured a slave is really supposed to be dead. Cannibalism appears to have been little practised. War canoes are no longer in existence, but formerly there were several in each district. Ceremonies were carried out before departure. If an enemy made a raid on the island, revenge was taken by attacking the aggressors and carrying off a captive, who was sacrificed. A festival was held in honour of a manslayer after the return of an expedition, for which the giver of the feast had to collect food, mainly pigs and taro. A feast was also held after the first successful raid of a new canoe.

**Duckbilled Platypus**—In *Blackwood's Magazine* for May (p 717), H. A. Roome gives some interesting notes on his attempts to keep the duckbilled platypus in captivity during a stay in Tasmania in 1888. The

animals' behaviour as described does not give the impression of low mentality at all, they displayed a disconcerting activity in climbing wire-netting as soon as confronted with it, and a pair which were kept for about a week exhibited playfulness which would have been noteworthy in any mammal, gambolling together not only in the water of their tank, but also among the weeds of their enclosure. It is unfortunate that the duckbill, unlike its fellow-monotreme the echidna, is so delicate in captivity, the pair above mentioned having so soon succumbed although supplied with natural food from a pond. Bennett did better with a pair of young ones in 1860, allowing them the run of a room and feeding them on artificial food, yet they lived little more than a month. A few years ago, however, a platypus was successfully taken to America and exhibited, being fed on shrimps and earthworms. Probably an experienced convoyer of the more delicate insectivorous birds would succeed with this most interesting mammal.

**Development of the Vertebral Column**—What may perhaps be called the standard account of the development of the vertebral column in the Gnathostomata, since it occurs in many textbooks, is based upon the investigations of Gadow and Abbott. Subsequent work has shown that this account is in need of revision in various important points. Prof E. W. MacBride has performed a useful service in surveying the researches into this problem in Elasmobranchs (Ride-wood), Teleostei (Ramanujam), Amphibia (Mookerjee), Aves (Pücher), and Mammalia (Dawes) which were carried out in the Department of Zoology at the Imperial College of Science (*Biological Reviews*, April 1932). In a brief notice it is not possible to refer to all the details dealt with in what is itself a condensed review. The vertebræ in most Elasmobranchs, save a few primitive forms, are not chordacentrous but their centra are perichordal. They are also perichordal in all the higher groups, and the arcualia—basidorsals, basiventrals, and ribs—are developed in the myocommata. There is a much closer fundamental agreement between the various groups than was generally supposed, and not the great break between Amphibia and Amniota. The important difference between these groups is not in the method of formation of the vertebræ, but in the fact that in the latter alone (or at any rate in the Mammalia) five anterior segments of the vertebral column fuse with the skull. The paper is illustrated by forty-eight text-figures, but it is a pity in so useful a work that some of them are badly drawn, and the reader is not aided in tracing the originals, as there is no direct acknowledgment of their origin.

**Size and Shape Factors in Fruits**—Plant varieties are often distinguished by the size or shape of their fruits, but relatively little is known regarding the genetics of these differences. An interesting contribution to the subject has been made by Dr E. W. Sinnott (*J. Heredity*, vol 22, No 12), who crossed varieties of *Cucurbita pepo*. In some races the fruits may be five times as long as their diameter, while in those with flat fruits the width may be three times the length. Some of the types isolated also differed greatly in size of fruit. In crosses, certain shape differences showed sharp monohybrid segregation in  $F_2$ . A study was made of the relation between size and shape in certain crosses. Two pure lines which differed markedly in fruit size and shape were crossed. One had a small spherical or pea-shaped fruit

(average diameter, 11 cm, average weight, 700 gm) The other had a large disc-shaped fruit (7 cm  $\times$  18 cm, 1300 gm weight) The disc shape is completely dominant, with a 3 : 1 ratio in  $F_2$ . But the  $F_2$  discs and spheres were of the same average weight (about 1030 gm) The  $F_2$  fruits showed greater variability in weight than the  $F_1$ , suggesting multiple factors for size. Thus there was present a single pair of factors governing fruit shape, presumably acting through control of growth correlation, and a series of factors governing volume or weight, and probably effective through control of the amount of material at the command of the growing fruit. The size factors appear, moreover, to be independent of the shape factors, and there is no evidence for the existence of genetic factors directly controlling single dimensions.

**The Magma of Vesuvius**—In *Die Naturwissenschaften* for April 29, Dr A. Rittmann discusses the origin of the magma represented by the lavas of Vesuvius. The prehistoric lavas of Monte Somma can be satisfactorily regarded as *vicoite* (sanidine bearing leucite-tephrite) and its leucocratic and melanocratic differentiation products, leucite-phonolite and *ottajanite* respectively. Leucite-phonolite was last erupted in A.D. 79, when Pompeii was overwhelmed. Since then, Vesuvius has developed from a magma having the composition of leucite-tephrite. No significant variation has been observed in the lavas from 1631 to the present day. Variation diagrams show that the Vesuvius magma lies within the range covered by the earlier Somma magmas. It is clear, however, from the chemical and mineral characters, that the Vesuvius magma cannot be a residual magma produced by the separation of early formed crystals from the *vicoite* magma of Somma. Dr Rittmann suggests that the difference can be ascribed to assimilation of the Triassic dolomitic limestone that underlies the volcanic pile, accompanied by crystallisation differentiation. The separation and sinking of aggregates of augite, biotite, olivine, and anorthite, represented by ejected blocks of *missourite*, *pughanite*, *sebastianite*, *biotite-pyroxenite*, and *olivine-pyroxenite*, would remove from the system *vicoite* plus dolomitic limestone just those constituents required to leave a magma relatively impoverished in magnesia and silica and enriched in alkalis and gases. The hypothesis is one which will readily commend itself to most petrologists. It should, however, be noticed that assimilation of carbonates does not here provide an origin for the alkali-rich character of the original magma of Somma, but only for the change in composition from *vicoite* to leucite-tephrite.

**The Shyok Ice Barrier**—In view of the disastrous flooding from the Shyok lake in the Karakoram in 1929, a note on the present state of the ice dam is of interest. It was visited in 1931 by Capt C. E. C. Gregory, who records his observations in the *Himalayan Journal* for April 1932. The snout of the Chong Kumdan glacier which dams the valley was then about 1500 yards wide and about 200 feet high, and the lake behind it had a surface area of over thirty miles, and was standing 30-40 feet below its highest level. The ice is apparently in a state of retreat, but there is little loss of water from the lake by percolation through the dam. The deep channel cut in the ice by the burst of 1929 had completely healed in a year. Estimating from the steady rise in the waters of the lake, Capt Gregory believes that it will overflow or burst the barrier again in 1932. Major K. Mason, discussing the problem from the data available, thinks that degeneration of the glacier snout

will allow heavy percolation of water and so relief of pressure, and provided the normal high level of water in the summer of this year is safely passed, there will be no further danger of a burst for many years. He is not, however, so sure as Capt Gregory of the probability of a serious burst during this summer.

**Hair Hygrometer**—The hair hygrometer is the simplest type of instrument for indicating the relative humidity of the air without the necessity either for calculations or the use of charts. Being dependent for its functioning on the reproducibility of the hygroscopic properties of hair, this form of hygrometer needs checking from time to time by reference to a ventilated wet and dry bulb hygrometer or a dew point apparatus. Messrs. Negretti and Zambra have recently placed on the market a compact form of hair hygrometer. The instrument is of circular pattern, measuring 4 inches in diameter by  $1\frac{1}{2}$  inches in depth, and is described by the makers as being a wall or pocket type. The scale is enamelled on metal, and therefore not liable to distort with humidity changes as sometimes happens with paper scales. The operating mechanism is simple, consisting of a bundle of hairs anchored at one end, passing over a pulley, and coupled at the other end to a variable throw crank. Tension is maintained by a spring. The variable throw crank permits of control on the magnification of the movement, so that the scale can be adapted to a particular bunch of hair. The usual form of zero adjustment is provided. A few precautions are necessary in the use of an instrument of this type: (1) it should not be exposed to direct sunshine, otherwise errors will be introduced, due to the warming up of the blackened case of the instrument and the lowering of the relative humidity of the air inside, (2) time must be allowed for equilibrium to be reached if the instrument is taken from an atmosphere of one humidity into another of a different humidity, since the air has to diffuse into the instrument through slits in the case.

**Origin of the  $\gamma$ -Rays from Actinium Emanation**—Two observations have been made recently on the properties of the radioactive gas actinon which afford evidence for the hypothesis that  $\gamma$ -rays have their origin in transitions of  $\alpha$ -particles inside an excited nucleus, and not in the movement of electrons (*Roy Soc. Proc.*, May). The first consists in an observation by W. B. Lewis and C. B. Wynn-Williams with an electrical counter on the  $\alpha$ -particles from actinon, which has shown that these are heterogeneous, one of the two groups emitted has a range in air of 5.6 cm, and the other a range of 5.2 cm. On the above theory of the  $\gamma$ -rays, the difference in energy,  $3.6 \times 10^5$  electron-volts, should also appear as a  $\gamma$ -ray quantum in the actinon-actinium A disintegration. That this probably occurs has been shown by Lord Rutherford and B. V. Bowden by a second set of experiments, in which the radiation from a current of air containing actinon was examined with a Geiger-Müller tube counter, and  $\gamma$ -rays of about the expected penetrating power found. Before these observations it had been supposed that the emanation emitted only  $\alpha$ -rays, but in addition to the  $\gamma$ -radiation, a weak  $\beta$ -radiation, probably due to internal conversion of the  $\gamma$ -rays in their escape from the nucleus, has also been detected with an electroscope.

**The Theory of Radiation**—This problem, an outstanding example of the incomplete success of modern quantum theory, is discussed at some length by Prof. C. G. Darwin in the May number of the *Proceedings of the Royal Society*. An essential point in the modified theory which he outlines is that the general similarity

of electrons and photons in behaving both as particles and waves should be recognised. The difficulties which arise from the apparent annihilation of a photon when it is absorbed can be neglected, at least in the first instance, but it is necessary to make an abrupt departure from earlier work by treating the electric force in an electromagnetic wave as an unobservable quantity, it is not considered identical with a static electric force, or even with the force in wireless waves when they involve a large number of photons, but is taken to be a quantity like the  $\psi$  of wave-mechanics, and a set of six components of the electric and magnetic vectors adopted as wave-functions. Development of this idea then leads, as for the electron, to the difficulty that states of negative energy should arise, and, as appears also to be done now for the electron, this is deliberately ignored. Prof Darwin remarks that the troubles of the quantum theory are apparently increased by this, but that it is usually found that the best hope of resolving a deep difficulty is to extend its application as far as possible. Further elaboration furnishes the angular momentum of the quantum, analogous to the spin of the electron, and with it an example of the duality of the quantum theory, in insisting both

that the angular momentum of a system must be an exact multiple of the quantum and that it is impossible to measure it to the nearest quantum. The remainder of the paper deals in a preliminary way with the perturbation of a photon by an electron. In the same number of the *Proceedings*, Dr P. A. M. Dirac gives an account of a quantum theory in which the interactions between particles take place by means of vibrations of an intervening medium transmitted with a finite velocity, and Prof Wasastjerna discusses the quantum statistics of X-rays.

#### Natural Regulators of Protein Metabolism in Plants.

—Mothes has published a highly interesting note on this subject (*Naturwiss.*, 6, 102, 1932) in which he claims that a regulator can be extracted from plants, which largely determines whether proteins are built up or broken down. The substance is acetone soluble, and it activates protein hydrolysis when in a reduced form but not when in its oxidised form. In the former case, it reacts with sodium nitroprusside to indicate a sulphhydryl grouping. Its further investigation obviously promises a considerable addition to our knowledge of the vexed questions surrounding protein synthesis in plants.

### Astronomical Topics

**Magnetic Disturbance of May 29-30**—A considerable magnetic disturbance was registered at the Greenwich magnetic station of Abinger on May 29-30 last. The ranges of the three elements during the disturbance, which began rather indefinitely at about 11<sup>h</sup> on May 29, were as follows: declination 35', horizontal force 340  $\gamma$ , and vertical force 265  $\gamma$ . This disturbance of 'storm' range is the largest recorded at Abinger since March 1929. The sun's activity is now definitely declining towards the minimum phase of the eleven-year cycle, when magnetic disturbances of this magnitude are usually very infrequent.

At the time of the commencement of the 'storm', a fairly conspicuous spot was about 3 days past transit of the sun's central meridian. This suggests a connexion with the storm, though in appearance and size the sunspot was not unusual. On the few occasions at Greenwich when breaks in cloudy skies permitted the spot to be observed spectroscopically (when it was near the centre of the sun's disc) the hydrogen atmosphere in the region of the spot was distinctly active but not to an abnormal degree.

**The Arizona Expedition for the Study of Meteors**—For many years observations of meteors have been actively carried on in the United States. As the results seemed to indicate that many meteors were moving with hyperbolic velocities, and were therefore visitors to the solar system from the stellar regions, it was seen that statistical study would increase our knowledge of the character and amount of the matter that exists in interstellar space, which is of importance in many problems relating to the star system. Accordingly, Prof H. Shapley, with the co-operation of Dr Opik and Prof Boothroyd, has organised an expedition to the clear air of Arizona, for the statistical study of meteors (*Proc. Nat. Acad. Sci.*, Jan 15, 1932). The Lowell Observatory is accommodating one of the parties, while others are placed at distances of 2 miles and 23 miles from it, there is thus material for obtaining the real paths of doubly observed meteors. Each observer has the position of his eye fixed by looking through a tube, and the area of sky visible is limited by a square opening, through which a region

80° by 80° is visible. The opening is crossed by bars, which are used to fix the tracks more exactly. There is a rocking mirror that is used for part of the time to determine the speeds of meteors. A star appears as an ellipse in the mirror, but a meteor appears as a wavy curve, the distance between the crests of the waves gives the speed. There is good reason to hope that the results will lead to a great increase of our knowledge of meteors.

Mr. J. P. M. Prentice, director of the Meteor Section of the B. A. A., notes that there is still plenty of scope for amateur work on meteors, the Arizona expedition is mainly to secure general statistics, whereas his section keeps watch on special showers, such as the Perseids, Leonids, etc. These showers are known to belong to the solar system, whereas the special concern of the American expedition is to investigate the cosmical meteors, which come from outside. Of course, the observations must include all the meteors seen, since their relation to the solar system can be inferred only after subsequent discussion.

**The Star 70 Ophiuchi**—This is an interesting double star which has for a long time perplexed computers owing to apparent irregularities in the motion, this caused suspicion that there might be a third unseen companion, but no satisfactory verification of this supposition has hitherto been obtained. *Lick Bulletin* No. 443 contains a study of this star by Mr. L. Berman. He has examined the radial velocity of the brighter component, and finds that, in addition to the large wave with a period of 88 years due to the known component, there are decided indications of a smaller wave with a period of 18 years, which he ascribes to a small companion (the mass of which is estimated to be between one-tenth and one-fifth of the sun's) revolving round it. The inclination of this orbit is concluded to be nearly 90°. He notes that the dynamics of this system, if it contains three stars of comparable mass and comparable size of orbits, would be extremely complex, and much work would be required before the exact effect on the motion of the visible pair could be estimated. The parallax is found to be 0.179".

## Congress of the South-Eastern Union of Scientific Societies

THE annual congress of the South-Eastern Union of Scientific Societies was held at the Civil Service Commission, Burlington Gardens, W.1, on June 1-4, the presidential chair being occupied by Dr R E Mortimer Wheeler, keeper of the London Museum. Recalling to mind that the Emperor Augustus was probably the first museum-curator of a kind, as recorded by Suetonius, Dr Wheeler said that the goal of archaeological research is not only the collection of potsherds and the like, but also the reconstruction therefrom of all that has in the past been most vital in human thought and action. The story of Grettir the Strong is that of one of the earliest excavators known to history. Determined to defy the ghost of Kar the Old, he ordered that tools should be made ready for digging up the mound of Kar, and his companion having been scared away by the ghost, Grettir worked alone and brought out much treasure of gold and silver. He also kept silence about it, his enthusiasm not being entirely of an unselfish character. Treasure-hunting remained the main objective until well into the nineteenth century. The despoiling of barrows died hard. In 1844 the *Archæological Journal* recorded the opening of eight barrows in two hours on Breach Downs in the presence of a company assembled for the purpose. It was for them a holiday diversion to see weapons, urns, beads, bones, or glass vessels brought to light and scattered around. No wonder that archæology in its early days had to fight for recognition as a scientific pursuit worthy of intelligent minds.

The amateurishness of the excavations of early Victorian times was no doubt responsible for the low estimation in which archæology was held, but the situation was completely altered with the arrival on the scene of General Pitt-Rivers, who late in life came into possession of a fortune and a large estate in a district of unsurpassed antiquarian interest. It was in Cranborne Chase that the science of archæology was really discovered. British enterprise in the science is now at the full-tide. Not only in our own country but also all over the world, the spade and fork are in capable and energetic hands. But more trained observers and workers are needed. There is lack of the means by which such training can be arrived at. There is now an opportunity such as can never again be seized. An Institute of Archæology is needed, and with the building of a new University of London it is imperative that provision be made for such an Institute. Dr Wheeler appealed for support of the scheme which has been promulgated by Sir Charles Peers and others.

In the absence of Sir J. Arthur Thomson, a lecture was delivered by Dr Landsborough Thomson on bird migration, a subject which gives rise to many surmises but about which very little is really understood. The ringing of migrant birds has yielded a good many facts, but at present the return of only some 3 or 4 per cent of marked birds has been noted. Migration cannot be regarded as the result of reasoning. There is no compulsion which makes swallows, for example, breed in England in preference to South Africa, where they find a summer in our winter time. They can have no actual knowledge of our winter climate. We call the conduct of migrant birds instinctive and inherited, but this explains nothing. The true homing instinct is shown in the return of some to their old breeding-places year after year. In this they are aided by their powers of sight, but the actual reasons of their return are unknown. It is one of the great problems yet to be unravelled.

In the Geological Section, Prof H L Hawkins dealt with "Some Episodes in the Growth of South-Eastern England." East of a line joining the Wash with the head of Lyme Bay, the area is almost entirely covered by Cretaceous or later deposits, but just outside it palæozoic rocks, the pre-Cambrian and Carboniferous, reach the surface in South Leicestershire and the Mendips, and they extend into the area under the newer cover of rocks. These two ancient series of rocks give a clue to the foundations of the area. The Charnian line passes from Leicestershire in a south-easterly direction under east London, and the Mendip line takes a mainly easterly course linking Frome with Dover. The influence of the latter is seen in the east and west trends of the later rocks. The southern edge of the palæozoic massif under the North Downs is as clearly defined as is its western edge by the Mendips and their extension through Pembrokeshire. Assuming a northern edge determined by the Midland ridge and an eastern margin of similar rocks under the North Sea, we find postulated a nearly square basin, bounded by palæozoic ridges, with its corners at London, Bristol, the Wash, and near Ironbridge, and at each corner where the intersecting ridges cancel out are the exits of the chief rivers of the basin. In this basin Triassic and Jurassic rocks were developed on a grand scale. Prof Hawkins then gave his conception of the landscape of the area in Triassic times, the middle floor of the area, and passed on to the upper floor of Cretaceous time, when the uplift excluded the chalk sea. The south-easterly dip of the older systems then caused the elevation of the western parts before the eastern had emerged, thus resulting in a shoreline running north-east by south-west, which crept towards Dover as the uplift progressed.

In the Botanical Section, Mr J Ramsbottom, of the Natural History Museum, gave a paper on "Fungi as Scavengers", showing how humanity is indebted to these lowly organisms for many of the comforts of civilisation, and Mr A J Willmot followed with a paper on "The London Flora", as it was and as it now is.

Old-world enjoyment of life in the Middle Ages was the subject of "Medieval Games and Gaderings", by Dr W E St L Finny, and in the Zoological Section, Mr Hugh Main showed much of his excellent photographic work in "The Camera as a Naturalist's Recorder". Original slides from his own photographs illustrated Mr E J Bedford's "Some Ground-nesting Birds".

"Town and Country Planning" was dealt with by Mr G L Pepler in the Regional Survey Section, and it was pointed out that town-planning really includes that of rural districts, for the planning of one of the latter is in order to provide against irregular and bad planning when such parts come to be built over.

Some remarkable slide-pictures by Mr M Maxwell were shown by Capt Guy Dollman in his lecture on "Great Game Animals of Africa", and his lecture was a model of what a carefully prepared and well-delivered lecture should be.

Excursions to suit all scientific tastes occupied each afternoon, visits to the London Museum, the Natural History Museum, Zoological Gardens, Swancombe, Abbey Wood, Hampton Court, Burnham Beeches and other places being made. A four-hour cruise in the Port of London was a popular feature. Under the leadership of Mr A Farquharson, a survey walk was made in Westminster and Pimlico.

Prof E J Salisbury was elected president of the Congress for 1933, which will be held at Norwich.

## The Royal Observatory, Greenwich

### ANNUAL VISITATION

THE annual visitation of the Royal Observatory, Greenwich, took place on Saturday last, June 4, when the Astronomer Royal presented his Report to the Board of Visitors on the work of the Observatory during the past year. The Report begins with a statement of the progress that has been made in the construction of the two new instruments and the buildings for them, which are situated in the magnetic enclosure, at some distance from the present buildings. The large concrete block, 15 ft square and 9 ft thick, on which the transit circle will rest, is in position, and the piers for the collimators, each distant fifty feet from the instrument, are in position. Messrs Cooke, Troughton and Simms have already completed the three objectives, each of 7 in aperture. The transit micrometer is to be motor-driven. The circles will be 24 in in diameter. It is proposed to construct one circle of glass, the divisions will be read through the glass, and will be protected at the back by a metal plate, to obviate the need for cleaning, it is found that this is apt to cause slight changes in the divisions in the course of time. The Johnstone Yapp 36-in reflecting telescope is being constructed by the firm of Sir Howard Grubb, Parsons and Co. A large part of the mechanical work is completed, also the smaller mirrors. The mounting will be of the modified English type. The building of the dome is far advanced.

The usual observations have been carried on with the Transit Circle. The moon was observed on 74 days, the correction indicated to Brown's longitude of the moon in 1931 is  $+4.8''$ , it has been steadily diminishing since 1924, when it was  $+7.2''$ , the correction to the latitude has remained nearly constant at about  $-0.8''$ . The proper motions of stars in Boss's General Catalogue have been revised—those of the remaining stars brighter than mag 8.0 in the zone N Decl  $32^\circ$  to  $40^\circ$ . 311 double stars were measured with the 28-in equatorial, 55 of them were closer than  $0.5''$ . 1223 plates were taken for stellar parallax with the 26-in equatorial, 1128 plates were measured, and parallaxes of 37 stars deduced, results were given in *Monthly Notices* of the Royal Astronomical Society for November last.

The programme of work on star temperatures has been carried on with the 30-in reflector, a volume is in press containing the absolute colour temperatures of 25 standard stars and 38 other stars. 106 plates were taken with the astrophotographic equatorial for the determination of proper motions in the Greenwich zone, which extends from Decl  $64^\circ$  to the pole. This work has now been completed and is nearly ready for press.

Photographs of the sun were obtained on 261 days, the missing days are filled in with plates from the Cape and Kodaikanal. Sunspot activity has continued to diminish, and the minimum is expected in a year or two. Observations were made with the spectrohelioscope on 154 days, measures of radial velocities of flocculi have been published in *Monthly Notices* of the Royal Astronomical Society.

The Report describes the preparations for the solar eclipse of Aug 31 next, Dr J Jackson and Mr C R Davidson are going to Parent, on the Canadian National Railway, which will also be occupied by a party from Ottawa Observatory. Mr Worthington has lent a 6-in lens of 45 ft focus for photographs of the corona, various spectroscopic researches will be carried on.

A determination has been made of the longitude and latitude of the Abinger magnetic observatory, they are  $0^\circ 23' 12.06''$  W,  $51^\circ 11' 5.17''$  N. The

magnetic elements for 1931 are Decl  $12^\circ 13' 7''$  W, Hor Force 0.18544, Vert Force 0.42923, Dip  $66^\circ 38' 1''$ .

The following weather statistics refer to the year ended April 30, 1932, the averages with which they are compared being those of the 75 years 1841–1915. The mean temperature had the exact average value  $49.5^\circ$ . The maximum was  $81.2^\circ$  on July 12, the minimum  $20.6^\circ$  on Dec 31. There were 49 days of temperature  $32^\circ$  or lower. The mean daily movement of the air was 281 miles, which is 4 below the average. The maximum was 691 miles on Dec 4. The duration of bright sunshine was 1180 hours, there were 87 entirely sunless days. The rainfall was 23.89 inches, which is 0.35 below the average, the wettest and driest months were August and February, with 6.27 and 0.29 inches respectively.

Observations for time were made with the small reversible transit instrument on 63 nights. On Feb 18 last, Shortt No 11 was adopted as the standard sidereal clock instead of Shortt No 3, the latter has been fitted with a new invar pendulum and bob.

The rhythmic time-signals have been sent to Rugby at  $10^h$  and  $18^h$ , they are now preceded by warning signals. The usual comparison of time-signals with those of Paris, Nauen, Annapolis, and Bordeaux is given in the report, they are, in the mean, later than Greenwich by  $0.007^s$ ,  $0.031^s$ ,  $0.026^s$ , and  $0.015^s$  respectively.

The Astronomer Royal observes that this is his last annual Report to the Board, and gives a summary of the work carried on at the Observatory since his appointment in 1910.

## University and Educational Intelligence

**BIRMINGHAM**—Dr L J Wills has been appointed to the chair of geology, to succeed Prof W S Boulton, who retires at the end of the current session.

Mr William Gemmill, honorary surgeon to the Queen's Hospital, has been appointed joint professor of surgery, to succeed the late Prof William Billington.

**CAMBRIDGE**—It is proposed to appoint a Syndicate consisting of the Vice-Chancellor, Dr E D Adrian, the University Treasurer, Prof R H Fowler, Mr F T Brooks, and Mr R E Priestley to consider the organisation of the research institutes in the University and their relations to the University and its departments, and to report to the University by the end of the Lent Term, 1933.

**LONDON**—Prof H V A Briscoe, since 1921 professor of inorganic and physical chemistry at Armstrong College, Newcastle-on-Tyne, has been appointed to the chair of inorganic chemistry at Imperial College (Royal College of Science) as from Oct 1, 1932.

Mr S G M Ure, since 1921 lecturer in chemical engineering at the Imperial College, has been appointed reader.

The title of professor of physical chemistry in the University has been conferred on Dr Samuel Sugden, in respect of the post held by him at Birkbeck College.

Prof F A von Hayek has been reappointed to the Tooke chair of economic science and statistics tenable at the London School of Economics.

The Dunn Exhibitions in Anatomy and Physiology for 1932 have been awarded respectively to Mr J E Spalding and Mr W N Mann, both of Guy's Hospital Medical School.

**WALES**—Applications are invited for the following scholarships. The Mrs John Nixon Research Scholarship in the Department of Medicine and



Medical Pathology, value £150, the Lord Merthyr Research Scholarship in the Department of Surgery, value £200, and the Ewen Maclean Research Scholarship in the Department of Obstetrics and Gynaecology, value £150. Applications must reach the Registrar, University Registry, Cathays Park, Cardiff, not later than Sept 1

A FELLOWSHIP for research in aeronautics is being offered by the Armourers and Brasiers' Company, the tenure of which will be two years and the annual value £300. Applications must reach the Clerk to the Company, Armourers' Hall, 81 Coleman Street, E C 2, by, at latest, June 30

APPLICATIONS are invited by the Agricultural Research Council for three agricultural research scholarships, each of the yearly value of £200 and tenable for not more than three years, and for two veterinary research fellowships, value £300 a year and tenable for not more than three years. All candidates must be nominated by a professor or lecturer of a university, college, or medical school, or by the director of a research institute. Forms and full particulars can be obtained from the Secretary, Agricultural Research Council, 6A Dean's Yard, S W 1

THE education of American Indians and Negroes and natives of the principal outlying possessions of the United States—Hawaii, Porto Rico, the Philippines, and Alaska—is dealt with in *Bulletin*, 1931, No 20, of the Office of Education, Washington. This survey of American experience during the past ten years of educational problems arising from the necessity of integrating people of widely different racial origin, traditions, and beliefs in a new social and economic order will be read with interest by educational administrators in other parts of the world, notably in the African dependencies of Great Britain. Educational policies have aimed at preserving the best in native cultures, as well as the special gifts and talents with which, as individuals and groups, the native and minority peoples are endowed, and at transferring responsibility for administration, supervision, and instruction, as rapidly as possible, to the groups themselves. In Porto Rico and in the Philippines, such a transfer has practically been achieved. In Alaska, the Eskimos and Indians are still to a considerable extent dependent on the guidance of the missionary-teachers sent out by the authorities at Washington. Also in Hawaii, Porto Rico, and the Philippines, increasing attention is devoted to the 'practical' as distinguished from the academic side of secondary school objectives. In Porto Rico, under the pressure of the havoc wrought by a tornado, a new type of rural secondary school has been successfully introduced, in which the courses are based wholly on a vocational programme, with emphasis on those trades which are economically productive in the island.

### Calendar of Geographical Exploration

#### June 12, 1789 —The Mutiny on the *Bounty*

Capt William Bligh and a few companions who had been cast adrift in a small boat by mutineers reached Timor safely after having covered 3600 miles. Bligh had been sent out in 1787 in the *Bounty* to transport bread-fruit trees to the West Indies in the hope of introducing their production in those islands. Bligh rounded the Cape of Good Hope and discovered the Bounty group of islets south-east of New Zealand. A long stay was made at Tahiti and numbers of bread-fruit trees obtained, the *Bounty* then sailing for Java.

To the north of the Cook or Hervey group, Aitutaki island was discovered, and the ship put in for refreshments at the Friendly Islands. The crew considered these South Sea islands to be ideal and mutinied, hoping to enjoy a life of ease in one of them. Some of them became the ancestors of the Pitcairn Islanders. Bligh in the overladen boat, without a chart and with insufficient provisions, had to make his way from the Friendly Islands to Timor. He found a passage through the Great Barrier Reef in about 13° S and discovered Restoration Island.

#### June 15, 1869 —East Coast of Greenland

Koldewey's expedition sailed from Bremen, and with him was Payer, the future discoverer of Franz Josef Land. One vessel, the *Hansa*, got separated and crushed in the ice. Her crew built a house on an ice-floe, but this was broken by the splitting of the floe. They drifted, sometimes on their melting island and sometimes in boats, for more than 1100 miles, but finally reached the coast of Greenland in lat 60° N. The other ship, the *Germania*, had better fortune and Koldewey and Payer reached Sabine Island off the east coast of Greenland, named Kaiser Wilhelm Land, and partly explored Franz Josef Fiord.

#### June 17, 1853 —The North-west Passage

Capt R. M'Clure and his officers and crew arrived safely on board the *Resolute*, having been rescued by Lieut Pim from Banks Island, at a point where M'Clure was, in desperation, about to attempt the same southward journey to the Canadian coast which had proved fatal to Franklin's party. M'Clure had not only discovered but also traversed a north-west passage, partly by a land journey over ice. For this solution of a long-standing Arctic problem M'Clure was knighted and a sum of £10,000 was voted to himself, the other officers, and the crew. M'Clure in the *Investigator* left England in January 1850, with Collinson in the *Enterprise*, but they were accidentally separated before reaching Bering Strait. M'Clure penetrated the arctic from the west and passed the winter of 1850-51 at the Princess Royal Islands, only 30 miles from Barrow Strait. He found it impossible to reach Barrow Strait, though he could see it, because of heavy ice. He wintered on the north coast of Banks Island in 1851-52, and was preparing to abandon the ship in the spring of 1853, when help fortunately arrived. Collinson also succeeded in finding a north-west passage, and after three winters in the arctic returned home in 1854.

#### June 18, 1851 —The Niger and its Tributaries

Dr Barth reached the junction of the Faro River with the Benué, here half a mile wide, yet 415 miles distant in a direct line from its confluence with the Niger. He had set out with Richardson and Overweg, under government auspices, to explore the Niger region, starting from Tripoli. At the frontiers of Bornu the party separated, and Richardson and Overweg shortly afterwards died. Barth's extensive travels yielded a rich harvest of geographical, ethnographical, historical, and philological data. He explored the great bend of the Niger, visited the Tuareg tribes and the Hombori mountains, and reached Timbuktu. Thence he explored the Hausa States and saw the miserable villages which were all that remained of the once powerful Songhay Empire, ruined by the attacks of Moors, Tuareg, and Fulah. The interest aroused by Barth's discovery that the Benué so closely approached Lake Chad resulted in a government survey of the possibilities of navigation of the river. Major Laird was in charge, and 340 miles were accurately charted.

## Societies and Academies

## LONDON

Royal Society, June 2—C U Ariens Kappers. Some correlations between the brain and the skull (David Ferrier lecture). While the brain-case generally adapts itself to the form and growth of the brain, the author begins by giving some examples in which a one-sided external compression (Teleostomes) or a more general space economy in the neurocranium (birds) seems to be the primary factor in determining some external (and internal) morphological features of the brain. He then discusses the brain and skull shape in mammals in relation to bodily characteristics and intrinsic changes in the brain itself, and their influence on the general and fissural aspect of the pallium. Proceeding to the possibility of establishing anthropological differences in the brain, the author discusses the use of certain standard lines, angles, and indices for expressing such differences in figures. He then proceeds to the general and fissural brain morphology of races in which, in addition to other features, the height index of the skull differs a good deal, and he compares the brachy-hypsicephalic Armenian with platy-brachycephalic Northern Mongol and the latter with meso- or subbrachy-hypsicephalic Chinese brain. Further, the Chinese brain is compared with the Japanese brain. The very limited possibility of using the same standard lines for endocranial casts of extinct races is discussed. The brain (endocranial cast) of Dubois' *Pithecanthropus erectus* is compared with the chimpanzee's and orang utan's. Then follows a discussion of the frontal region in recent man, especially Negro races, and the fissural changes in this region in connexion with cytotoxic and functional fields, chiefly in the vicinity of the mid-frontal. The phenomena observed in fissural development in general are briefly discussed. With the anthropological differences in the brain, which doubtless occur, we should try to differentiate between brain variations primarily depending on, or at least correlated with, the skull and intrinsic changes in the brain.

Optical Society, May 12—J W Perry. The  $F/1.8$  quartz monochromator-spectrograph. The circumstances in which large monochromators and spectrographs of especially high illuminating power are requisite are discussed, and the dependence of illuminating power and instrument efficiency upon the essential optical characteristics of such instruments is investigated. A description is given of a large instrument fulfilling the combined functions of monochromator and spectrograph, the relative aperture of which varies from  $F/1.6$  at  $0.185 \mu$  to  $F/2.0$  at  $1.2 \mu$ , and records of performance are described.—R F Hanstock. The transmission of light in diffusing media. The transmission of light by thin films of diffusing material is investigated, a flicker photometer being used for this purpose. The intensity  $I$  of the diffuse light transmitted in the direction normal to the surface is related to the film thickness  $x$  by the empirical equation

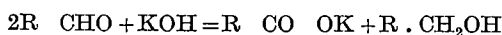
$$1/I = C(1 + ax + (ax)^2),$$

where  $a$  is a constant depending on the opacity of the material of the film to diffuse light and  $C$  is approximately constant for all substances. The ability of a film to hide a contrasting background is proportional to the quantity  $H = 1/I$ , complete hiding being attained for a value of  $H$  which is constant for a variety of white and coloured paints and papers. An accurate method of measuring the opacity or hiding power of such films is described.

## PARIS

Academy of Sciences, April 25—Gabriel Bertrand and Mme M Rosenblatt. The unequal proportions of manganese in green leaves and etiolated leaves. Green leaves are richer in manganese than etiolated leaves.—R Fosse, P De Graeve, and P E Thomas. A new plant principle: uric acid. Uric acid has been extracted from various seeds (especially from *Mehlotus officinalis*). It was identified by its crystalline form, by elementary analysis, and its reactions.—Andre Blondel. A new algebraical representation of alternating currents and of other oscillatory phenomena. The notation suggested facilitates rapidity of calculations and their physical interpretation in the applications of electricity and other oscillatory phenomena.—Louis Roy. The elastic line in the fundamental equations of the resistance of materials.—E Kogbetliantz. The developments of Laguerre.—C E Winn. The convergence of a series derived from another series with limited variation.—Arnaud Denjoy. The continuity of singular analytical functions.—Michel Fekete. The number of changes of sign of a function in an interval and its moments.—de Seguer. The classes of substitutions of order 2 of linear, quadratic, Hermitian, and left groups in a Galois field of odd order.—N Moukhelekhvili. The problem of torsion of compound elastic beams.—V Smirnov and S Soboloff. The plane problem of elastic vibrations.—B Galerkin. The equilibrium of a thick circular plate in the form of a circular sector.—Alfred Rosenblatt. The stability of the Couette movements of viscous liquids.—R Swyngedauw. The rational calculation of pulley belts.—R Wavre. The extension of a theorem of Stokes relating to fluid stars.—D Belorizky. The radius of convergence of the series in the problem of two bodies, treated by Levi-Civita's method.—P Guntini. The distribution of the residual velocities of  $B$ -type stars.—J Dufay. The energy curve of the star  $P$  Cygni. The energy curve of this star is not that of a black body.—Ch H Muntz. The resolution of the dynamical problem of elasticity.—Marcel Mennesson. A method of measuring lengths and thicknesses with high precision. Air under constant pressure flows through an orifice the section of which is a function of the length to be measured. The volume of air passed is determined by reading a length on a water manometer. A change of length of  $0.01 \text{ mm}$  is thus amplified to  $500 \text{ mm}$  on the manometer.—Pierre Vernotte. The measurement of the thermal conductivity of bad conductors: the calorimeter method.—Leon Grillet. The electrical conductivity of black paper. Applications.—M Pauthenier and P Delahaye. The electrostriction of benzene.—Charles Dietsch. A method of measuring high intensities of continuous current.—R Chevallier. The magnetisation of macroscopic powders in weak fields.—R Freymann. The absorption spectra of ethylene and benzene derivatives in the infra-red.—J Rabinovitch. The rotatory dispersions of benzene solutions of  $d$ - $\alpha$ -pinene and  $l$ - $\beta$ -pinene. Correction to a preceding note.—Horia Hulubei. Contribution to the study of the Raman spectrum of water.—H Buisson, C Jausseran, and P Rouard. The transparency of the lower atmosphere.—Mlle Y Cauchois. The spectrography of the X-rays by the transmission of a non-canalised pencil through a curved crystal.—Georges Fournier. The composition of atomic nuclei.—H Barjot. The rational utilisation of solar heat.—D Skobelzyn. The spectrum of the  $\gamma$ -rays derived from thorium.—Miles C Chamie and A Korvezee. Centrifuging alkaline solutions of polonium.—Pierre Montagne. The formation of acetylene, starting with methane at low pressure, under the influence of condensed sparks. A study of the conditions (pressure of methane, capacity of condensers) giving the highest

yield of acetylene according to the equation  $2\text{CH}_4 = \text{C}_2\text{H}_2 + 3\text{H}_2$ —H Figour and P Jacquet Comparison of the electrolytic deposits of zinc and cadmium from the point of view of the protection of steel against corrosion Zinc deposited from a sulphate bath is less resistant to corrosion than that deposited from a cyanide bath The method of testing for corrosion is not a matter of indifference Thus in a salt fog or in a wet warm atmosphere, cadmium protects steel better than zinc, but in outside air zinc is more resistant—Georges Allard The influence of substitutions on the frequencies of organic bodies—Ch Zinzadze The preparation of trimagnesium phosphate—B Bogitch The principles of the treatment of nickel minerals—L Palfray, S Sabetay, and Mlle Denise Sontag A method of determining aldehydes based on the reactions of Cannizzaro and of Claisen The method is based on the reaction



On account of its high boiling point, benzyl alcohol is used as the solvent for the potash The aromatic aldehydes have been proved to react quantitatively in the sense of the above equation—M Battegay and L Deniville The chlorides of the arylsulphuric acids,  $\text{ArO SO}_2\text{Cl}$ —P Mognaud The method of determining fluorine—Jacques Duche The action of ether and chloroform on the Actinomyces of the asteroid group—R J Gautheret The production of chlorophyll in roots exposed to light, especially in the root of barley—Pierre Chouard and Georges Teissier Relations between the growth of various parts of melon seedlings and the quantity of reserves left at the disposition of the embryo—Charles Perez The small sexual differences of cuticular ornamentation in *Eupagurus*—P Vignon The morphological explanation of the wings in the Diptera and Coleoptera—A Back and R Legendre The sexual state of *Germo alalonga* during the fishing season—Mlle Anne Raffy The variations of dissolved oxygen consumption during the death of marine stenohaline fishes passing from fresh water to sea water—Raoul M May The lasting action, as a substitute, of the intraocular graft of the thyroid from a newly born rat on the development of a white rat the thyroid of which had been removed—A Radoeff Researches on the stimulation of growth and of metabolism in the tissues of wheat The acceleration of growth produced by a preliminary treatment of seeds with solutions of salts of certain metals (manganese, magnesium, zinc) has been proved (Popoff, Bertrand, Brenchley) Experiments on the metabolism of plants stimulated in this way confirmed the increase in growth, but gave negative results for increased metabolism—Raymond-Hamet The sympatholytic poisons The possibility of transforming, by a vaso-dilative action, the vaso-constrictive action of those amines not inverting the hypertensive action

#### VIENNA

Academy of Sciences, Feb 11—Franz Ackerl Force of gravity at the geoid—Josef Norbert Dorr The migration of birds and moonlight In many cases it is difficult to observe any dependence of the times of the spring and autumn flights of birds on the meteorological conditions Observations made over a long series of years in Austria, Hungary, France, Switzerland, etc., show that the main flights of those birds which are mainly night-migrants occur during the periods favoured by moonlight—Fritz Wessely and Franz Lechner 1 2 3 4-tetrahydroxybenzene derivatives Synthesis of 6 7 8-trihydroxycoumarin and of dimethylfraxetin An improved method of preparing 1 2 3 4-tetrahydroxybenzene, and also its conversion into 6 7 8-trihydroxycoumarin and

dimethylfraxetin, are described—Leopold Schmid and Richard Huber Colouring matter of *Papaver rhoeas*—Carl Wirtz Photometric observations with the great (67 cm) refractor of the observatory at the University of Vienna The observations described were made mostly on Saturn's system—Joseph B Niederl The structure of acetone-cresol condensation products—Heribert Grubitsch The processes occurring during the galvanising of iron—Wolfgang Grobner Minimal bases for the invariant bodies of cyclic and metacyclic permutation groups—Eberhard Geyer Short account of the anthropological results of the Lappland expedition of 1913–14 supported by the Vienna Academy of Sciences The measurements made and the photographs taken during this expedition indicate mixing of the Lapps with their Scandinavian neighbours and with Asiatic (North Siberian) tribes

Feb 18—Norbert Lichtenacker Geomorphological investigations in the French Alps. A survey is given of the geological development of the French Alps—Franz Lippay Contraction of skeletal muscle during deficient formation of lactic acid The large quantities of lactic acid regularly appearing during the permanent contraction of striped muscle are by some considered to bear a causal relationship to such contraction The author's experimental results show that this is not the case, although the course of the contraction may be influenced by the lactic acid, the sense of such influence is, however, not the same with muscle contracted by means of chloroform as with muscle contracted by heat—Franz Werner Results of a zoological expedition to Morocco in 1930 (4) Orthoptera More than ninety Moroccan species, ten of them not previously described, are discussed The main work of the expedition consisted in revision of the Moroccan species from various difficult genera, such as *Hololampra*, *Pyrgomorpha*, *Acinipe*, and *Eurypteryphes* A number of species were found on the Great Atlas Mountains at a height of more than 2500 metres—Oswald Richter New contributions to photosynthesis and photolysis, principally in living plants By means of the so-called 'artificial high sun' (made by Messrs Heraeus of Hanau), which furnishes extraordinarily intense ultra-violet rays, particularly those of wave-length below  $300\mu$ , a number of the effects of such rays have been studied These include, for example, the decomposition of chlorophyll—which is easily effected in leaves of *Tropaeolum majus*, *Robinia pseudacacia*, and *Iris florentina*—the hydrolysis of starch, the decomposition of anthocyan, necrosis colorations, etc

### Forthcoming Events

#### FRIDAY, JUNE 10

ROYAL ANTHROPOLOGICAL INSTITUTE (Sociological Research Meeting), at 4—Dr Fortes and others Discussion on Cultural Stages

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Annual General Meeting), at 5—E Clarke Tay's Choroiditis

ROYAL SOCIETY OF MEDICINE (Laryngology and Otology Sections) (at Eye and Ear Hospital, Portsmouth)—Summer Meeting (continued on June 11)

#### MONDAY, JUNE 13

MIDDLESEX HOSPITAL MEDICAL SCHOOL, at 5—Dr A T Wilson The Physiology of the Adrenal Gland (Succeeding Lecture on June 16)

#### TUESDAY, JUNE 14

LONDON HOSPITAL MEDICAL COLLEGE, at 5 15—Dr J R Marrack The Structure of Molecules in Relation to

- Biology and Medicine (*Succeeding Lectures on June 16, 21, 23, 28, and 30*)  
 EUGENICS SOCIETY (at Linnean Society), at 5 30—Dr A S Paterson The Law of Anticipation in Mental Disease  
 INSTITUTION OF PETROLEUM TECHNOLOGISTS (Special Summer Meeting) (at Royal Society of Arts), at 5 30

## WEDNESDAY, JUNE 15

- RESEARCH DEFENCE SOCIETY (Annual General Meeting) (at London School of Hygiene and Tropical Medicine), at 3—Sir Arthur Keith Some Aspects of the Modern Conflict between Reason and Sentiment (Stephen Paget Memorial Lecture)  
 INSTITUTION OF MINING ENGINEERS (Summer Meeting) (at Sheffield) (*continued on June 16 and 17*)  
 ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute)—Annual Election of Committee and Officers

## THURSDAY, JUNE 16

- ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Annual General Meeting) (at Manson House, 26 Portland Place, W 1), at 8—At 8 15—Col S P James, Prof W Schulemann, Prof N H Swellengrebel, Dr C A Henry, and others Discussion on Synthetic Anti-Malarial Preparations and Quinine

## FRIDAY, JUNE 17

- PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5—Prof Max Planck The Concept of Causality in Physics (Guthrie Lecture)  
 ILLUMINATING ENGINEERING SOCIETY (Annual General Meeting) (at Royal Society of Arts), at 7 15—Sir Francis Goodenough Presidential Address

JUNE 16 TO 18

- ANNUAL COLLOID SYMPOSIUM (at Ottawa, Canada)

## Official Publications Received

## BRITISH

- Proceedings of the Royal Society of Victoria Vol 44 (New Series), Part 1, 29th February Pp iv+102+14 plates (Melbourne)  
 The Journal of the Indian Mathematical Society Vol 19, No 7, February Pp 137 160+153 176 (Madras) 18 rupees  
 The Himalayan Journal Records of the Himalayan Club Edited by Kenneth Mason Vol 4, 1932 Pp vi+225+v+22 plates (Calcutta Thacker's Press and Directories, Ltd., London W Thacker and Co) 5 rupees, 8s  
 Indian Central Cotton Committee Technological Laboratory Technological Bulletin, Series A, No 19 Application of Different Systems of High Draft Spinning to Mixings of Indian Cottons By N P Richardson and Dr Nazir Ahmad Pp ii+38 (Bombay) 18 rupees  
 Mines Department Safety in Mines Research Board Paper No 74 International Conference on Safety in Mines at Buxton, 1931 Pp 67+11 plates (London H M Stationery Office) 1s 6d net  
 Transactions and Proceedings of the New Zealand Institute Vol 82, Parts 3 and 4, March Pp xxii+179-271 (Dunedin)  
 The Scientific Proceedings of the Royal Dublin Society Vol 20 (N S), No 18 A Critical Review of some Recent Work on the Occurrence of Virus Complexes in the Potato By Dr Paul A. Murphy Pp 193 210 1s 6d Vol 20 (N S), No 20 The Compound Nature of Crinkle, and its Production by means of a Mixture of Viruses By Dr Paul A. Murphy and Robert M'Kay Pp 227 247+plates 10 12 2s 6d (Dublin Hodges, Figgis and Co., London Williams and Norgate, Ltd)  
 Proceedings of the Society for Psychical Research Part 124, Vol 40, May Pp 363 387 (London Society for Psychical Research) 3s 6d  
 Education (Scotland) Report for the Year 1931, by the Director, on the Royal Scottish Museum, Edinburgh Pp 18 (Edinburgh)  
 The Scientific Journal of the Royal College of Science Vol 2 containing Papers read during the Session 1931-1932, before the Imperial College Chemical Society, the Royal College of Science Natural History Society, the Royal College of Science Mathematical and Physical Society Pp 163 (London Edward Arnold and Co) 7s 6d  
 Journal of the Society of Glass Technology Edited by Prof W E S Turner Vol 16, No 61, March Pp xiv+xi+32+110+138+xx xiv (Sheffield The University) 10s 6d  
 Air Ministry Aeronautical Research Committee Reports and Memoranda No 1441 (T 3168) Investigation of Atmospheric Turbulence by Aircraft carrying Accelerometers By W G Jennings, R P Alston and C Howarth Pp 6+5 plates 6d net No 1446 (Strut 44) Control Column giving Warning of Dangerous Wing Loads By H E Wimperis Pp 6+1 plate 6d net No 1453 (T 3186) The Interference on the Characteristics of an Aerofoil in a Wind Tunnel of Circular Section By H Glauert Pp 12 9d net No 1448 (T 3122) Full Scale Lift and Drag Curves of a Standard Seaplane By A S Crouch Pp 4+7 plates, 6d net (London H M Stationery Office)  
 Loughborough College, Leicestershire Calendar, Session 1932-33 Pp xvi+258+55 plates (Loughborough) 2s 6d net

British Science Guild The Annual Report of the Council of Management, 1931-32, presented at the General Meeting of Members, held at the Royal Society of Arts, John Street, Adelphi, London, on Wednesday, 25th May 1932 Pp 16 (London British Science Guild) 1s

Canada Department of Mines Mines Branch Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories) 1930 (No 724) Pp iv+215 (Ottawa F A Acland)

Ontario Research Foundation Report for the Year 1931 presented by the Chairman to the Lieutenant Governor in Council, December 1931 Pp 34 (Toronto Herbert H Ball)

Publications of the Dominion Astrophysical Observatory, Victoria, B C Vol 5, No 1 The Radial Velocities of 528 O and B Type Stars obtained at Victoria, 1923-1929 By J S Plaskett and J A Pearce Pp 98 25 cents Vol 5, No 2 A Catalogue of the Radial Velocities of O and B Type Stars By J S Plaskett and J A Pearce Pp 99 165 25 cents (Ottawa F A Acland)

Palaeontological Bulletin Bulletin No 1 The Tertiary Geology of East Gippisland, Victoria, as shown in Borings and Quarry Sections By Fredk Chapman and Irene Crespin Pp 15 (Melbourne H J Green)

Union of South Africa Report of the South African Museum for the Year ended 31st December 1931 Pp 19 (Pretoria Government Printing Office)

## FOREIGN

Proceedings of the United States National Museum Vol 79, Art 30 Design Areas in Oceania based on Specimens in the United States National Museum By Herbert W Krieger (No 2896) Pp 53+33 plates Vol 80, Art 16 The Ancient Caves of Szechwan Province, China By David Crockett Graham (No 2916) Pp 13+16 plates Vol 80, Art 19 A Review of the Nematodes of the Genus *Hysterospiculum*, with Descriptions of Two New Species By B G Chitwood (No 2919) Pp 9+3 plates Vol 80, Art 20 Records of Dipterous Insects of the Family Tachinidae reared by the late George Dimmock, with Description of One New Species and Notes on the Genus *Anetua* Robineau-Desvoidy By J M Aldrich (No 2920) Pp 8 (Washington, D C Government Printing Office)

U S Department of Agriculture Farmers' Bulletin No 1691 How to Control Grasshoppers in Cereal and Forage Crops By J R Parker and W R Walton and R L Shotwell Pp ii+14 5 cents Technical Bulletin No 296 Feeding Punctures of Mirids and other Plant sucking Insects and their Effect on Cotton By W V King and W S Cook Pp 12 5 cents (Washington, D C Government Printing Office)

Annals of the Astrophysical Observatory of the Smithsonian Institution Vol 5 By C G Abbot, L B Aldrich and F E Fowle (Publication No 3121) Pp ix+295+11 plates (Washington, D C Government Printing Office)

Bulletin of the American Museum of Natural History Vol 64 The Distribution of Bird Life in Guatemala, a Contribution to a Study of the Origin of Central American Bird Life By Ludlow Griscom Pp ix+439 (New York City)

The Physiology of Large Reptiles with Special Reference to the Heat Production of Snakes, Turtles, Lizards and Alligators By Francis G Benedict (Publication No 425) Pp x+539 (Washington, D C Carnegie Institution)

University of Colorado Studies Vol 19, No 2 Dominant Ideas in the Works of Guy de Maupassant By Roy Alan Cox Pp 77-157 (Boulder, Colo) 1 dollar

The Science Reports of the Tohoku Imperial University, Sendai, Japan First Series (Mathematics, Physics, Chemistry), Vol 21, No 1, March Pp 192 (Tokyo and Sendai Maruzen Co, Ltd)

Journal of the Faculty of Engineering, Tokyo Imperial University Vol 20, No 4 Stresses in a Plate with Two Holes, and the Examination of Cogate Problems By Seinen Yokota Pp 99 113 (Tokyo Maruzen Co, Ltd)

Japanese Journal of Physics Transactions and Abstracts, Vol 7 Pp v+46+46+3 plates (Tokyo National Research Council of Japan)  
 Publications de l'Observatoire de Genève Rapport sur les concours de réglage de chronometres de l'année 1931 Pp 27 (Genève)

The Oriental Institute of the University of Chicago In Commemoration of the dedication of the Oriental Institute Building, December fifth, 1931 Pp iv+68 (Chicago)

U S Department of the Interior Geological Survey Bulletin 827 A Geologic Reconnaissance of the Dennison Fork District, Alaska By J B Mertie, Jr Pp iv+44+8 plates 45 cents Bulletin 830 A Copper Deposits near Keating, Oregon By James Gillyly (Contributions to Economic Geology, 1931-32, Part 1) Pp ii+32+3 plates 15 cents Professional Paper 170 B The Upper Cretaceous Ammonite Genus *Barroisiceras* in the United States By John B Reeside, Jr (Shorter Contributions to General Geology, 1931) Pp ii+9 29+plates 3 10 25 cents Professional Paper 170 D Pliocene Fossils from Limestone in Southern Florida By Wendell C Mansfield (Shorter Contributions to General Geology, 1931) Pp ii+43 56+plates 14 18 15 cents (Washington, D C Government Printing Office)

Smithsonian Miscellaneous Collections Vol 87, No 6 Composition of the Caddoan Linguistic Stock By Alexander Lesser and Gene Weltfish (Publication 3141) Pp 15 (Washington, D C Smithsonian Institution)

Nebraska Geological Survey Bulletin 5, Second Series Brachiopoda of the Pennsylvanian System in Nebraska By Carl O Dunbar and G E Condra Pp 434+44 plates (Lincoln Nebr)

## CATALOGUES

Watson's Microscope Record No 26, May Pp 24 (London W Watson and Sons, Ltd)

Spectrograph of Great Intensity (Lispec 31) Pp 4 Analytical Balance in Brass Case (Improved Model) (Mac 31) Pp 2 Vacuum Iron Arc Lamp for Spectroscopic Work (Boog 31) Pp 2 (Delft P J K P en Zonen)

Folklore and Anthropology (Catalogue No 549) Pp 74 (London Francis Edwards, Ltd)

Micro-Projection Apparatus Pp 6 (Manchester Plattens and Garnett, Ltd)

Gaster Siccata B D H (Desiccated Stomach) Pp 12 (London The British Drug Houses, Ltd)



SATURDAY, JUNE 18, 1932

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No 3268, Vol 129]

## Co-operation in Medical and Agricultural Research

AT a meeting of the New Zealand Branch of the British Medical Association held in March last, a resolution was approved urging the necessity for further research regarding the "factors which govern the incidence of goitre, in particular its relationship to the nature of the soil and the food of the people", and recommending that arrangements should be made to co-ordinate medical research with soil and animal research

Goitre, which occurs in both human beings and animals, is an endemic disease which appears to be correlated with the nature of the soil and, according to most observers, with the iodine content of the food. A great deal of research has already been done, especially in Switzerland, the United States of America, and in India, but the problem of the etiology of the disease and the best means of its prevention are by no means completely solved. The resolution to co-ordinate work on soils, domestic animals, and human beings is undoubtedly sound.

Investigations on these lines have been carried out in Great Britain in recent years. The greatest obstacle to progress is the difficulty of determining with accuracy the amounts of iodine present in soils and foodstuffs. A committee of the Medical Research Council, with the assistance of Sir Robert Robertson, of the Government Chemical Laboratory, is at present trying to evolve a method which will give trustworthy data and can be used as a standard method throughout the world. If such a method be found, the advance in our knowledge will certainly be along the lines suggested by the New Zealand Medical Conference. It is probable that through the Imperial Agricultural Bureaux, the Medical Research Council, the Public Health Departments, and the Agricultural Research Council, co-operative research not only between medical, veterinary, and agricultural research workers, but also between institutions in different parts of the Empire, may be arranged. It is by such co-operative work that the goitre problem is most likely to be solved.

That such co-operation should not be limited to the question of goitre is emphasised by a message from Lord Bledisloe, the Governor-General, to the New Zealand medical conference. Lord Bledisloe has, for many years, shown a deep interest in veterinary and agricultural research, and in his message he directs attention to the interrelation of human and animal food deficiency diseases. He refers specially to diseases "traceable to lack of

iron, calcium, iodine, phosphates, vitamins, or other essential food factors", and points out that these diseases, which have a common etiology in both human beings and farm animals, require further investigation

A number of deficiency diseases, for example, Waihi disease in cattle due to phosphorus deficiency, bush sickness to iron deficiency, goitre believed to be associated with iodine deficiency, and several diseases in sheep which may be due to lack of either calcium or phosphorus or both, are already being successfully investigated in New Zealand. There is evidence that similar mineral deficiencies occur under certain conditions in the food of human beings, and there is no doubt that lack of some of the vitamins is of common occurrence in large sections of the world's population

The wealth of knowledge which research in nutrition has accumulated in the past few years, perhaps on account of its very newness, has not yet been fully applied to the prevention of disease in human beings and domestic animals. The lead given by Lord Bledisloe for the combination of medical, veterinary, and agricultural research resources for an attack on diseases the incidence of which is influenced directly or indirectly by nutrition is therefore timely, and deserves the attention of those responsible for the direction of medical and agricultural research in other countries as well as in New Zealand

### Towards a New World Order

- (1) *Letters to John Bull and Others* By Robert the Peeler Pp 140 (London Williams and Norgate, Ltd, 1931) Paper, 2s 6d, cloth, 3s 6d
- (2) *The League Committees and World Order a Study of the Permanent Expert Committees of the League of Nations as an Instrument of International Government* By H R G Greaves Pp xi + 266 (London Oxford University Press, 1932) 14s net
- (3) *The Economic Consequences of Power Production* By Fred Henderson Pp 220 (London George Allen and Unwin, Ltd, 1932) 6s net
- (4) *The Riddle of Rationalisation a Review of the Potentialities of the Scientific Reorganisation of Industry under a National Plan* By L J Barley Pp 128 (London George Allen and Unwin, Ltd, 1932) 4s 6d net

FOR some years before the present trade slump and the economic crisis of last year, acute observers had perceived the bankruptcy of many

accepted political and economic theories and the inadequacy of the administration in most western countries to deal with these problems with which the accelerated application of scientific discoveries and methods in all fields of industry and of society was confronting them. The War itself was only a revelation of this bankruptcy and inadequacy in regard to national defence and security, and the halting progress towards disarmament during the last fourteen years underlines that failure. To an unprejudiced observer, the governments of the world as a whole appear to have "learnt nothing, forgotten everything"

The present critical position must be largely attributed to the failure of those in authority to perceive the fundamental changes which have occurred during the last fifty years in the whole character of industry and society, despite repeated warnings. We can recall no more lucid exposition of the fundamental change in human relations for which applied science has been responsible than Prof J T Shotwell gives in an admirable introductory chapter to his book on the Kellogg Pact, but the indifference of the politician and even of industry to such warnings suggests something more deliberate than neglect. The volumes under review have this in common, that from different angles they present an invaluable and constructive analysis of the underlying causes of our difficulties and supply the outline of what to most sane and disinterested persons will appear to be a reasonable solution, and one that in its emphasis on facts and freedom from prejudice or preconceived ideas should command the earnest consideration of all scientific workers

(1) "Letters to John Bull and Others" is a popular and spirited exposition of the idea of an International Police Force so ably expounded by Major David Davies at greater length in the "Problem of the Twentieth Century". This restatement of the essential points is exceedingly timely and should promote a wider understanding of the problems confronting the Disarmament Conference. "Robert the Peeler", in entertaining but convincing manner, contrives to lay bare the fundamental principles of real progress. The new weapons which science has forged have made disarmament and the renunciation of war the only alternative to annihilation, but he goes further and suggests that by co-operation in an International Police Force the new weapons can be used for the mutual protection of all countries, science having created the conditions which make it possible to supply to the modern world the prin-



ciples and methods successfully practised centuries ago by the Greeks

The very extent to which the new weapons dominate warfare makes it possible to contemplate handing them over to a small international authority and force which would consequently have a striking power out of all proportion to its numbers and, under modern conditions of transport, could take rapid and effective action in any part of the world "Robert the Peeler" visualises this International Police Force in conjunction with an International Court of Justice and a tribunal to enforce the findings of which it would be primarily organised

Naturally, in a short popular work of this type, only the briefest outline can be given of the method of organising such a court or police force, but it is all to the good that as many people as possible should be induced to view the problem as a whole and consider impartially the idea of an International Police Force Apart from anything else, the existence of such a police force would eliminate decisively one of the gravest present dangers when no adequate defence is available against, for example, air attack, the temptation to get one's blow in first Nor does "Robert the Peeler" fail to note the folly and danger to society of allowing the continuance of vested interests in the manufacture and exploitation of the new weapons of war

(2) To destroy the underlying causes of war, by constructing channels of international co-operation and by creating a disinterested point of view wherever national interests conflict is, however, as Mr Greaves points out, vastly more important than declaring war the evil everyone knows it to be Disarmament is after all a negative aspect of the League, and one great merit of Mr Greaves's book is that it gives a connected account and a lucid analysis of the growth of the technical and administrative work of the League in its various expert committees and commissions and assesses their contribution towards the building of a new world order

The tendency for international organisation to extend is one of the most significant of modern times, and one which received further impetus during the War as indicated in the various inter-Allied systems for shipping control, food, and purchases The parallel tendency for government to rely increasingly on smaller and more specialised groups of men is equally striking and is changing the very nature of politics Government has become a thing impossible without the advice of experts and the schemes of technicians, upon whom

almost daily are thrust new and weighty functions The consequent danger of the legislature becoming the tool of its expert advisers is one to which in Great Britain Lord Hewart has directed attention, and the recent Committee of Inquiry, while recognising the tendency, did not regard it as fundamentally wrong but merely recommended the institution of certain safeguards

The more marked technicality of administration and the necessity for expert opinion are also supported by the need for securing the agreement of the organised and articulate interests affected in State action The outcome is seen in the practice of creating advisory committees of experts representing outside interests which act as permanent consultative bodies at the disposal of the government Accordingly, the functional representation of industry, upon the need for which under our new tariff policy Capt H Macmillan has rightly insisted, is only a process of devolution which is taking place to an increasing extent and reflects a further development of the basic principle of self-government

These three tendencies give special significance to the League's expert committees The growing number of questions which can only be solved by international co-operation, the increasing authority of the expert, and the advance towards functional self-government, stress the importance of these international committees, and this critical study of their development is at pains to elucidate the various factors which have contributed to their relative success or failure Designed in the main to be consultative, they have already achieved more than a mere advisory function, and although their members are appointed invariably in theory and usually in practice on technical qualifications, the fact that they are constantly in touch with their governments, although not government representatives, has enabled them to transform national into international administration with notable measure of success The most significant fact about these committees is, however, that each committee deals with its particular problems from a non-national point of view, exactly in the way visualised by General Smuts in his Sidgwick Memorial lecture when pleading for the scientific spirit in human affairs, especially in the international sphere

It should be unnecessary to stress this point further in view of the events of the past year, but the brief review of the activities of these committees which Mr Greaves gives us demonstrates plainly that their greatest successes, such as the reconstruction

schemes for Austria, Hungary, and the Greek refugees, are to be attributed to the greater urge which an aroused public opinion and the responsibility for a definite and urgent attack supplied. Equally it is true that in the lesser known but valuable work of the Health Committee, the Economic Committee, the Mandates Commission, or the Communications or Transit Committee, there can be found abundant evidence of the fruitfulness of this new method of handling difficult technical international questions, and that agreement and co-operation are not difficult to secure provided that the duty of securing it is entrusted to specialists more interested in their subject than in national politics or prestige.

While we have already the machinery for handling such questions in this way, which by its very operation co-ordinates technical organisation and develops habits of co-operation and mutual confidence as well as facilitating the growth of a world point of view upon the needs of a world society, the success of the method is largely proportional to the extent to which the personnel of the committee is disinterested. Members must be nominated not as representatives of their countries but as individuals and for their expert qualifications. The necessary influence and contact with the governments of their countries is best secured when their expert qualifications are combined with high personal standing not only professionally but also in the world of government departments. If the expert committee is marked out as a most helpful line of advance towards a new world order in which civilisation will gain control over the destructive forces released in the last fifty years, success can never be achieved until, on one hand, scientific workers are increasingly disposed to accept the social and political responsibilities which are now rightly theirs, and on the other hand, there is, in Great Britain at all events, a much greater readiness to admit the scientific worker to administrative posts on equal terms with experts drawn from other spheres.

The book deserves and demands attention from scientific workers in particular, for the problems which call for treatment in this way are increasing and urgent, and failure to solve them to-day makes solution or control no easier to-morrow. Scientific workers cannot evade their responsibilities for sharing in this task of shaping international government and, by securing a wider publicity for this type of administration, assisting the growth of the public opinion which will promote its success in the more difficult fields of disarmament or

treatment of minorities where political factors still prevent progress.

(3) In "The Economic Consequences of Power Production" Mr Fred Henderson contributes an able analysis of the effect of the immense increase in our productive powers which has resulted from the application of science to methods of production, particularly in relation to the distribution of wealth. The effect of science on production has been discussed largely as if it were a matter of efficiency of production alone, and its effects on distribution have commonly been disregarded or overlooked. This has been partly due to the fact that until recent years the existence of outside markets has tended to mask the full effect of what has really been a fundamental change produced by science in our methods of production. It is only in the last few years, as these outside markets have tended rapidly to disappear and in the Far East and elsewhere countries which were formerly consumers only have entered the ranks of producers and erected barriers against the entry of the goods produced elsewhere, that the resulting dislocation of trade and unemployment culminating in the present depression have forced us to realise the existence of maladjustment and the startling contrast between our success in effective production and our failure in distribution.

To the demonstration of this change and its mechanism Mr Henderson devotes the first and most lucid part of his book. What science has given us in the mechanical developments of the last half-century is not merely more production but also a new kind of production. A profound and vital change has taken place in the relation of human labour to the processes and products of the world's work. Human physical energy has been superseded by other and greater propellent powers. The human service associated with the machine has ceased to be labour in the old sense. It is now mainly a matter of admitting power to the machine and regulating its degree and direction. It is labour on a higher level of general intelligence than the old unskilled manual labour, and carries a greater strain of responsibility, but in intelligence and responsibility it has nothing in common with skilled craftsmanship. Accordingly, the technique of an industry and intimate knowledge of its processes, raw materials, and products tend to become concentrated in a small central staff of experts. Output in production has thus now only escaped from the limitations of physical energy, but skill has become so unimportant in many industries that the low-paid labour from

rural districts of Japan, China, or India can compete in all essential respects with experienced European operatives

This shifting of the function of measuring output from labour to non-human energies is the main factor responsible, through our failure to adjust our distributive system, for the present confusion. Every means by which, through rationalisation or fresh scientific discoveries or inventions, our efficiency or resources of power production are increased, decreases the volume of labour required to produce a given output, or, in other words, renders human labour obsolete. Now that previous-customer communities have equipped themselves in the same way for supplying their own industrial products and are protecting their home markets against the incursion of such products from outside, while simultaneously seeking outside markets for themselves, we are rapidly approaching a position in which the home market of every industrial country is unable to absorb the equivalent of its own output and finds the rest of the world closed against the surplus. Widespread and increasing unemployment is the result, and this position, in the midst of incredible abundance which the escape of production from the limits of human labour has made possible, is a grave indictment against our present distributive machinery.

Thus far Mr Henderson can scarcely fail to carry his readers with him. In the second part of the book he does not reach the same level in analysing the defects of our distributive system, nor does the book include anything more than the broadest constructive suggestions. None the less the main theme is incontestable. The fundamental change which science has made in our methods of production demands certain changes in the economy of distribution. The latter can no longer be allowed to remain on its pre-scientific age basis, and the extension of scientific method and planning into this field is long overdue. We have to face the creation of a new social order for making effective the release of mankind into an age of more abundant living, and the social control of production scientifically planned in relation to use and consumption up to the level of human needs affords the only basis for such a new order.

Mr Henderson, in directing attention to the profound changes involved by the new conditions of power production and by challenging frankly some of the assumptions in regard to costs of production, and the distribution of leisure and profits which are often too lightly made, renders a

notable service. "Man does not exist to serve the needs of an economic system", he rightly observes, and in the creation of the new social order the application of scientific methods and the impartial spirit of science to the solution of our social and economic problems may play a decisive part. We cannot return to the inefficient or wasteful methods of production of the past, but science must do more than merely increase efficiency of production. At least it is clear that no policy of muddling timidity or prejudice will meet the situation.

(4) "The Riddle of Rationalisation" is a much slighter study than Mr Henderson has given us, but in spite of the omission of any reference to the change in the position of labour in our industrial system produced by machine or power production, Major Barley gives a very competent review of the possibilities of the scientific reorganisation of industry from an industrial point of view. Without challenging, as Mr. Henderson has done, the basic principle of capital or private ownership upon which our present production system rests, he equally recognises that the rationalisation of industry and its scientific management, by increasing the efficiency of production, inevitably reduce the labour required for the same output and thus promote unemployment. Recognising that a return to pre-scientific and inefficient means of production is out of the question, Major Barley sees the solution in the planning of production to increase the standard of living, and the distribution of wealth proportionately with the increase in the efficiency of production resulting from the application of scientific methods or discoveries.

Probably some distribution of leisure may be simultaneously required, but the plea for the extension of scientific methods to the economic field, for constituting an accurate industrial science for the service of the community and for planning production and distribution so far as possible in relation to our known needs, cannot be ignored. A national plan makes scientific adjustment possible and may offer some prospect of solving the unemployment problem and increasing the standard of living of the whole community by fifty per cent, provided the plan is conceived on wide enough lines and appropriate international co-operation secures an adequate and unprejudiced treatment of such matters as reparations and war debts, tariffs, and the international price-level and credit system.

These are large assumptions, but not so large as the pessimistic assumption that science has nothing further to contribute or that its guidance will not

enable man to find a way to the control of those forces which the careless application of scientific discoveries and principles in the mechanical world has released. That simultaneously with increased efficiency of production there has been a perceptible though disproportionate increase in the general standard of living is at least of hopeful significance, and until national planning has been attempted on the lines Major Barley suggests, we remain without an answer to the questions whether it is possible to raise the standard of living and simultaneously to reduce unemployment to the required extent.

The concrete suggestion of a commission for individual industries under an expert National Advisory Economic Planning Department is similar to that since proposed by Capt Macmillan under the Tariff Commission, and, like that, is essentially an attempt to determine whether, without radical changes in the nature of society, it may not be possible to organise on scientific lines the production, distribution, and exchange of goods so that the needs of the whole community may be adequately served.

#### Plant Chemistry

*The Glycosides* By Dr E F Armstrong and K F Armstrong (Monographs on Biochemistry) Pp vii + 123 (London, New York and Toronto Longmans, Green and Co, Ltd, 1931) 12s 6d net

THIS healthy bud from a vigorous parent chronicles important advances in plant chemistry. A chapter in the senior author's earlier monograph, "The Simple Carbohydrates and the Glucosides", published in 1910, was called "The Natural and Synthetic Glucosides" and occupied 14 pages. This has now been expanded into the new volume, which fills 110 pages, exclusive of bibliography and indexes. The change of spelling from "glucosides" to "glycosides" is made in accordance with official practice, and is a recognition of the fact—apparently not realised in 1910—that sugars other than glucose take part in forming these characteristic plant condensation products.

Several hundred of these substances have now been identified. Many are of a very complex nature, and their investigation is correspondingly difficult. The nature of the sugar itself has to be established, it is in most cases one or another of the modifications of glucose, though benzoyl-glucose, primverose, vicianose, digitoxose, digitalose, and rhamnose have all been isolated from natural glycosides,

as have several disaccharides and trisaccharides. The non-sugar part of the molecule may belong to any of an unusually wide range of compounds—phenols, coumarins, anthoxanthins, anthocyanins, isothiocyanates, and many others, including some the structure of which has not yet been worked out. The term "aglucone" for these constituents of glycosides seems a little illogical, surely it should have been "aglycone".

From the last two chapters of the book it is clear that the precise rôle of glycosides in plant physiology still awaits elucidation from the further intensive research that is certain to be undertaken, if only for the reason that a number have definite and recognised pharmacological action, among the better known of these are the glycosides of digitalis and strophanthus.

The volume is as well produced as others in this series, though there are some minor printing errors. Little attention has been paid to uniformity in the lay-out of the tables, Tables 1, 3, and 6 are arranged on one principle, Table 2 on another, Tables 4 and 5 on another, and neither Table 2 nor Table 5 has any column headings at all. Type and paper are adequate, but the luxurious effect of the transverse gold lettering replacing the old vertical black type on the spine is rather marred by its relative illegibility and bad centring. A L BACHARACH

#### Principles of Modern Physics

*Modern Physics - a General Survey of its Principles*

By Rev. Theodor Wulf. Translated from the second German edition by C J Smith. Pp. xi + 469 (London Methuen and Co, Ltd, 1930) 35s net

THE sixth-form scholar and the first-year university student are in these days well catered for in the matter of textbooks of physics. To be sure, these in general conform to a standard pattern which lends itself to a grasp of detailed facts classified in a traditional and natural manner and to the requirements of examination tests. There has been a tendency, however, of late years to break away somewhat from this pattern, and the book under review constitutes a very notable departure indeed from accepted models. Assuming the "essential and final goal of Physics" to be "the derivation of phenomena on the basis of the internal structure of the smallest constituent particles of matter", the author states that his aim is to give a "co-ordinated account of the fundamental results of Physics". In consequence, he collects in a first part the facts about the material world.

which are concerned with movements of observable bodies, transmission of waves, gravitation, and the elastic properties of matter, and then proceeds to Part II, which opens with a chapter on the history of the atomic conception and the discovery of the chemical elements and their classification

Part II treats the states of aggregation, heat, and thermodynamics, with a discussion of the facts which help to the comprehension of the atomic hypothesis. From the concept of the simple atom, the author passes on in Part III to the phenomena of electricity and magnetism, utilising these to develop the idea of an atom with a structure, thus leading to the hypothesis of electrons and nuclei and the part which they play in the emission and absorption of energy by matter. Here will be found an elementary account of the Planck theory of full radiation, Bohr's theory of the emission of spectra, and generalities about the quantum hypothesis. To complete the picture of the physical world, there follows Part IV on the "Physics of the Ether", embracing a discussion of the phenomena of light and radiation in general, and leading to a short account of Einstein's theory.

It is a commonplace criticism of our system of scientific education to blame it for the production of students crammed with facts the significance and relationships of which they fail to comprehend. We are of the opinion that this is a criticism which overstates the seriousness of the situation, but in so far as it may be true, we can conceive of no better antidote to the so-called deadening effect of the customary textbook than to introduce the young student to this work. It gives a clear picture of the physical world, as consistent with our knowledge as is possible at present, and presents it as a model still incomplete, involving difficulties, and destined no doubt to be profoundly modified in the future. For this inculcation of a truly scientific and philosophic outlook the book is worthy of high praise and can be heartily recommended to sixth-form boy, university student, engineer, medical teacher—indeed, to anyone who may have, for one reason or another, acquired some knowledge of the physical sciences and desires to obtain an insight into their realm, and an understanding of the great changes which have taken place there of late and what effects these changes have produced on the traditional conceptions of space, time, and matter.

The translation appears to have been well done, and shows none of the stiffness of style which accompanies a too literal rendering of a foreign work.

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## Short Reviews

*Les Coaptations chez les insectes* Par Dr Jean Corset (Suppléments au Bulletin biologique de France et de Belgique, Supplément 13) Pp 337 + 2 pls (Paris Laboratoire d'Évolution des Êtres organisés, Les Presses universitaires de France, 1931) 85 francs

IN his introduction to this treatise, the author explains the origin and significance of the term 'coaptation'. He applies it in the sense adopted by M. Cuénot with reference to Arthropoda, and especially insects. A coaptation is defined as a reciprocal adjustment of two independent parts which perform, as the result of their union, a definite function. Examples of such devices are particularly numerous and well developed in connexion with integumentary parts or organs among insects, especially in the order Coleoptera.

M. Corset's memoir is divided into four parts, and in Part I he describes the anatomical features of coaptations as exhibited among diverse groups of insects. Special mention may be made of the interlocking mechanism of the ovipositor valves in Orthoptera, the elaborate articulatory devices in relation with the wing covers and thorax of Coleoptera and some Hemiptera, sutural interlocking of coleopterous elytra, various types of fore and hind wing union, and so on. Part II is concerned with the functional aspects of the subject, and, in this connexion, the puzzling problem of the curious mechanical perfection of parts, often in relation to their apparent feeble utility, is raised. In Part III the biological rôle of these various devices and mechanisms comes in for treatment. Of especial interest are the examples of their close convergence in structural detail among members of very different families and orders that are brought to notice.

Part IV. is more or less philosophical in scope and is devoted to evolutionary questions associated with the parts in question. This subject is rather fully discussed, and it appears to the author to demonstrate the adaptation of a means towards an end through the operation of a directive force or agency. The memoir is well illustrated, mostly by means of sections of the parts involved. It is, on the whole, a very readable work that is suggestive in its outlook. Its production, it may be added, has involved a good deal of original investigation into the structure of the various devices that are discussed.

A. D. IMMS

*An Introduction to Plant Physiology* By Dr W. O. James Pp viii + 260. (Oxford Clarendon Press, London Oxford University Press, 1931) 7s 6d net

PLANT physiology has few literary champions. There is not one comprehensive textbook on the subject suitable for students reading for a final degree in botany in Great Britain. Except where a junior university course such as that of First M.B. or intermediate science is actually given round a prescribed book (not a commendable practice), there is no botany textbook of that status which gives physiology a fair hearing.

Now we have the reverse. Although the author of this book disclaims the fulfilment of requirements of any formal syllabus, the subject matter dealt with is of the standard 'prescribed' for first-year university students, but whether such students are prepared to invest in a textbook specially for the physiology section is a different matter.

The science of plant physiology is still in the melting pot of hypothesis and conjecture, perhaps more so than any other science. Yet, Dr James has avoided most of the controversial matter, still keeping his subject alive and to the point. The order of topics is somewhat revolutionary, and thus, we believe, the value of the book is enhanced. Photosynthesis is considered very early in the book, whereas growth and germination are relegated to the end. Nitrogen metabolism receives much deeper consideration than hitherto, and the various forms of plant irritability are dealt with fairly, more after the Continental style than the British, which scarcely considered the subject at all.

The method of treatment is good and the style is excellent. The text throughout is well illustrated. A special feature is the detailed descriptions of experimental work, for, as the author says, "the success or otherwise of an experiment depends so often upon apparent trifles." One of the many details we note with enthusiasm is the discriminating treatment of the important phenomenon of permeability.

*Archæology of the Arkansas River Valley*. By W. K. Moorehead. With Supplementary Papers on *The Prehistoric Cultures of Oklahoma*, by J. B. Thoburn, and *The Exploration of Jacobs Cavern*, by C. Peabody. (Published for the Department of Archæology, Phillips Academy, Andover, Massachusetts.) Pp. x + 205. (New Haven. Yale University Press, London. Oxford University Press, 1931.) 18s. net.

In this volume Mr. Warren K. Moorehead records the results of a comprehensive survey of the archæology of the Arkansas River valley from its junction with the Mississippi near the Louisiana border to its upper waters. The archæological interest of the valley lies especially in the variety of its cultures. These reflect the geographical conditions, which range from the wooded lowlands at the mouth, where are found mound-builders of characteristic 'pottery-belt' type, to the 'buffalo country' with prehistoric settlements, which point to a more settled habit among Plains Indians before the introduction of the horse, and the desert area in which the river takes its rise. The Ozark Bluff-Dwellers, who have been described by Harrington, are within easy reach of the river, and there is an extension of Pueblo culture in western Kansas, probably a migration from Pecos.

The most interesting problem of the area is afforded by what is here called the Texan Panhandle culture of the upper Canadian, Cimarron, Red, and Arkansas rivers, characterised by 'slab-house' construction. Its origin and affinities are obscure. The suggested relation with either Pueblo or Mexican culture gives rise to difficulty from the

absence of features characteristic in these two cultures. Mr. Moorehead discusses the evidence very fully, but in the present state of knowledge there is no possibility of solution. His expectation that the problem will be solved within ten years is probably justified, judging by the progress at present being made in this area. The value of the volume as a contribution to the prehistory of America is much enhanced by the excellent illustrations.

*Digressions of a Man of Science*. By Sir A. Daniel Hall. Pp. 223. (London: Martin Hopkinson, Ltd., 1932.) 7s. 6d. net.

It is sometimes cast in the teeth of the man of science that his interests are narrow and lacking in culture, and that though he has something to say, his literary attainments are not such as to enable him to say it. Both gibes can, no doubt, be supported by examples. The author of these essays is, however, one of many scientific men whose writings make manifest the injustice of the taunts. The range of topics in these "Digressions" is so wide as to cause envy of the versatility of the mind that thinks deeply on philosophical and religious matters, as in "The Faith of a Man of Science" and "Science and Immortality", that can discuss with expert knowledge the economic and political problems of farming ("What Science has done for Farming"), or with equal facility and happy phrase, and with apt quotation from both prose and verse writers in our own and in other languages, handle such diverse subjects as country churches and their mural tablets, the sheep, shingles, and birds of Romney Marsh and Dungeness, the frequenters of auction-rooms, and ideal tulips, to mention a few examples from the twenty-two chapters. Some of the articles have already seen the light in newspapers or magazines, and thanks are due to Sir Daniel Hall for bringing them within the covers of a book. The insertion of the dates on which he penned each article would have added a personal element of much interest.

*Entwicklungsphysiologie der Tiere*. Von Dr. Paul Weiss. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 22.) Pp. xi + 138. (Dresden und Leipzig: Theodor Steinkopff, 1930.) 11 gold marks.

THIS presentation of border-line problems has no counterpart in the English language. Prof. Weiss has succeeded in bringing together under the title of developmental physiology a survey of the present fluidity imposed by experimental embryology on the older and somewhat effete morphology. This is the best presentation of the post-War change in outlook in biology.

The book deals in particular with the balanced growth of the embryo, organ formation, and the rôle of Spemann's 'organisators'. Growth is analysed in terms of cellular proliferation and cellular differentiation, and the characteristic features of growth *in vitro* and *in vivo* are compared. Metamorphoses and regeneration lead up to a final chapter dealing with recent theories in biology.



The *Dana* Expedition of 1928-1930

ON several occasions reference has been made in *NATURE* to the oceanographical expedition of the *Dana*, 1928-1930. With the support of various Departments of the Danish Government, the East Asiatic Company, and especially of the Carlsberg Foundation, Prof. Johs. Schmidt planned and directed a lengthy cruise in the tropical waters of the Indo-Pacific, to supplement his many years' investigations in the Atlantic and thus to complete the 'magic circle'. The volume now before us \*

is the first ripe fruit. Richly and beautifully illustrated, in clear print, it is professedly a popular account of the voyage with just sufficient leaven of scientific fact and theory to hold one's interest and make a connected story. The illustrations accompanying this article are from the volume.

The voyage began in June 1928 and ended in June 1930. The total distance logged was more than 65,000 nautical miles. The westward route was chosen in preference to the eastward, to take advantage of the prevailing trade-winds and currents of the Pacific. A brief account of the voyage with a chart of the route followed, and the names of the scientific workers and others engaged in the expedition, have already been given in *NATURE* (March 21 and 28, 1931).

The first biological discovery of importance in the Pacific was made between the Marquesas and Tahiti—the larva of a true freshwater eel. Before that, the chief aim of the expedition had been to study the horizontal distribution of the oxygen-free layer of intermediate water, which had been discovered on the first *Dana* Expedition in 1921-1922 and later rediscovered by the *Carnegie* in 1929. According to the hydrographer of the expedition (H. Thomsen) this peculiar phenomenon, unknown in the other great oceans, is due to the lack of vertical movements in the eastern waters of the Pacific. The

oxygen-free layer extends from Panama as far as Tahiti.

The present volume is an extended narrative of the cruise, or rather a series of narratives. It is evident that the members of the scientific staff as well as the leading officers kept a *Dagbog*, and each has been called upon to give his experiences during the voyage. There are twenty contributions in all, and the material has been so skilfully arranged that they dovetail into one another and present a con-

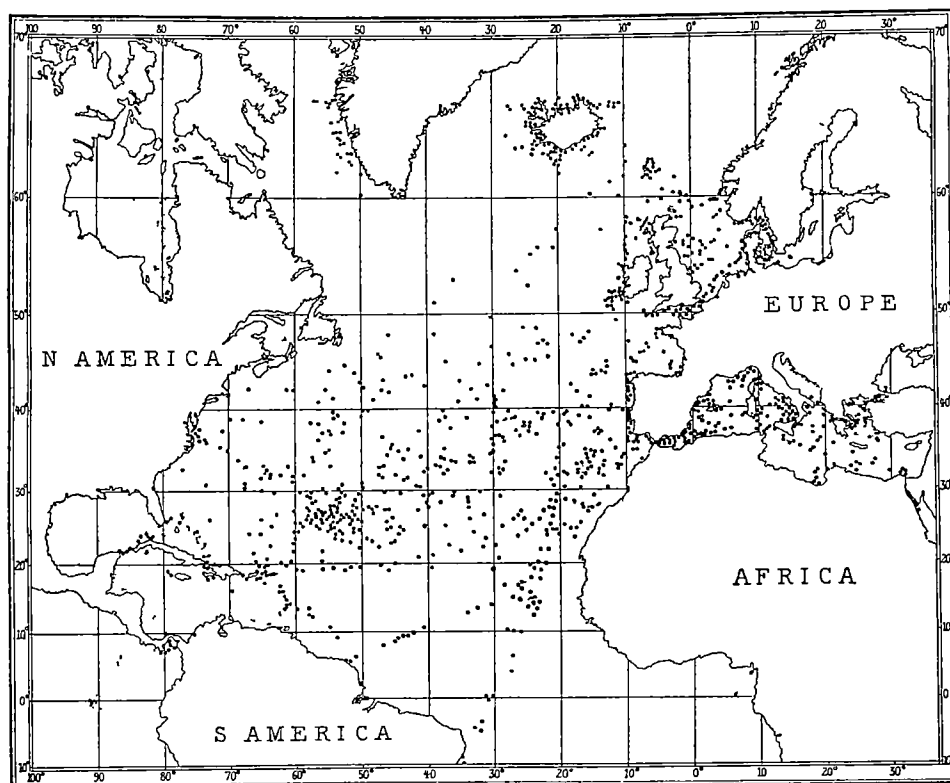


FIG. 1.—Stations in the Atlantic, 1928-1930

tinuous story of the voyage. The different ports and countries visited, excursions on land, the distinctive fauna and flora of the places, customs, costumes, and dances of the natives, earlier history, influence of traders and missionaries and so on, are all described and discussed with deft hands and discerning eyes. Old memories are here revived of Capt. Cook, the *Beagle*, atolls and palolo, tattooing and cannibalism, early Dutch and other adventurers, and especially of the time when the Danes also were pioneers in the discovery of the East.

It would be invidious, where the accomplishment of all is on such a high level, to single out any one of these living pictures for special reference, but an exception must be made in the case of "Christmas in New Zealand", by Fru Ingeborg Schmidt, wife of the leader of the expedition. Instead of appearing out of place in what is essentially a scientific if popularly written work, this account

\* *Dana's Tøgt Omkring Jorden, 1928-1930*. Af Prof. Johannes Schmidt. Pp. 368. (København Gyldendalske Boghandel, 1932) 9 75 kr.

is quite typical of the others. Christmas in the height of summer, a *Thuja* with sparkling lights for Christmas tree, *Risengrød med Mandel*, apple cakes and other Danish *Retter* kept in secret for the festival, visits to the many Danish colonists who have found a second Denmark round Palmerston in the North Island, the reception at Wellington, the wonderful grottoes of Waitomo, with the glow-worms (larvæ of *Boletophila luminosa*) spinning threads and lighting lamps to lure the small insects to destruction, the great forests, ferns and trees, birds and their songs—these and many other notes indicate that Fru Schmidt's journey across the world to meet the expedition at the antipodes was not wasted. The account makes no pretence

The scientific work of the expedition is touched upon in various chapters of this book of the cruise. To understand the references, one must hark back to Prof Schmidt's earlier activities in Atlantic waters. As is well known, after nearly twenty years of persistent search, Johs Schmidt discovered the birthplace of the European freshwater eel in the deepest part of the Atlantic at the western end of the Sargasso Sea. In the present volume, Prof Schmidt shows how his latest exploration of the Mediterranean with improved apparatus has confirmed his earlier conclusions. The *Leptocephali* of the common eel were found in quantities in the narrow Straits of Gibraltar and again in the cul-de-sac at the Straits of Messina, but occurred

only scattered elsewhere and in small numbers, particularly in the eastern basin. This points to an extensive immigration from west to east, similar to that in more northerly waters, and indicates that the eel does not spawn in the Mediterranean.

The eel investigations, however, representing perhaps the cream, count only as a fraction of the immense work accomplished. From North Iceland and the Davis Straits southwards to Brazil, and from the Baltic and Black Sea in the east to the United States and

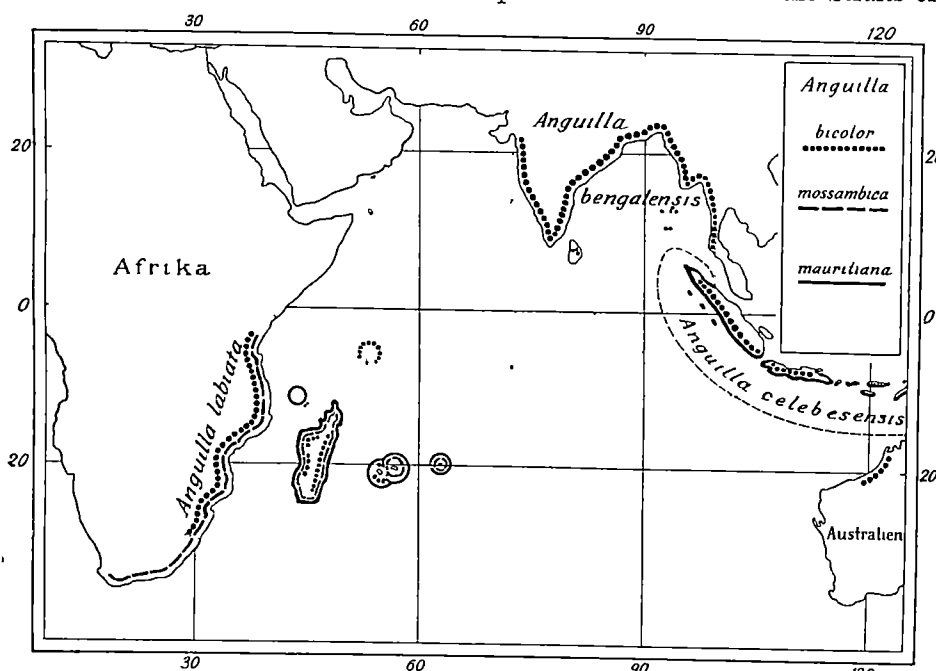


FIG 2—Distribution of eels of the Indian Ocean

to be other than a simple and faithful picture, yet it gives us a delightful glimpse of life and things in New Zealand.

It need scarcely be added that the expedition was received in all countries and places in the most hospitable manner—by government officials and scientific workers as well as by laymen. At many places indeed the reception was almost embarrassing, as in Samoa, where a native headman insisted upon displaying his family troubles along with his living spouse—by no means a skeleton. The expedition was able, however, to give as well as to receive entertainment. It carried two films descriptive of life and activities in Denmark and the Faroes, and these were shown, with lecture accompaniment, at a number of places in New Zealand, Australia, the Dutch East Indies, and South Africa. This book expresses the gratitude of the members of the expedition for the universal kindness, especially in the British Dominions and Colonies, but one may well believe that, with their soft speech and gentle manner, these Danes would be welcome guests anywhere and everywhere.

Panama in the west, Prof Schmidt and his collaborators have studied methodically the physical, chemical, and biological conditions of the waters from surface to bottom—so methodically that every square of 10° shows a number of stations on it, up to forty in the case of the more important, and the total number of stations has amounted in the course of time to more than twelve hundred. The chart reproduced as Fig 1 epitomises the regional distribution of the investigations. The material collected has been distributed to leading specialists in different countries, and the numerous volumes already published, though the Atlantic series is not yet complete, rival the reports of any other expedition in scientific interest and importance.

By intensive study of the variations, Prof Schmidt has been able to prove that two species of freshwater eels (*Anguilla*), and only two, occur in the Atlantic region, and both resort to about the same place to spawn. This deep part of the Atlantic is some 4000 miles away from Europe, yet the eels of all European countries, from Finland to Greece,

belong to the same race and go to and come from the same spawning region, the *Leptocephali* taking about three years to complete their pelagic wanderings. This remarkable fact, which, one may note incidentally, provides support for Wegener's theory of continental shifting, is in striking contrast to the conditions found in the Indo-Pacific Ocean.

Whereas only one species occurs over the wide expanse of Europe, the islands of the Pacific, for example Tahiti, have three separate species occurring together, and the so-called *Anguilla australis* of earlier zoologists has proved to contain no fewer than four species. In all, the Indian region contains six species (Fig. 2) and the Pacific has about twelve (some being common to both regions). These conclusions, based in the first instance on the adult characters, have now been confirmed by the discovery of the various *Leptocephali*. From the number of species and the conditions found there, Prof. Schmidt has come to the conclusion that the original home of the eels lay in the eastern ocean.

Deep water for, the purpose of spawning, and currents to convey the *Leptocephali* towards land, are apparently necessary for the existence of freshwater eels anywhere. Where one or other is lacking, as in the South Atlantic and on the western side of America, we find no eels in the adjacent countries, and in the Indo-Malayan Archipelago eels are only found in countries and on islands which face directly on to deep water. This is shown in Fig. 3, where the occurrence of eels is indicated by heavy blackening of the coast-lines. The shallow water areas north of Australia and between Borneo, Siam, and Sumatra contain no freshwater eels.

The islands of the Pacific and the coasts of India and East Africa obviously fulfil the requirements, and the *Leptocephali* have not so far to wander. It follows, almost as corollaries, that the Indo-Pacific *Leptocephali* are of smaller size than the Atlantic forms and metamorphose in a shorter time. Yet a remarkable thing is that the adults of several of the eastern species at Tahiti, in New Zealand and in the rivers of East Africa, are of gigantic proportions by comparison with the European and American eels.

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Other discoveries indicate that the tropical regions of the Atlantic and Pacific possess similar communities of eels (deep-water eels, not *Anguilla*), and that their distribution is closely connected with the hydrographical conditions. Thus, *Nessorhamphus ingolfianus* occurs in the transitional regions north and south of the equator, whereas *N. Danae*, with a similar number of vertebrae, occurs only along the equator. Such comparisons of the physical and biological phenomena in the different oceans were among the chief objects of the expedition.

The scientific horizon of Prof. Schmidt is, however, not bounded by the eel. One may recall that

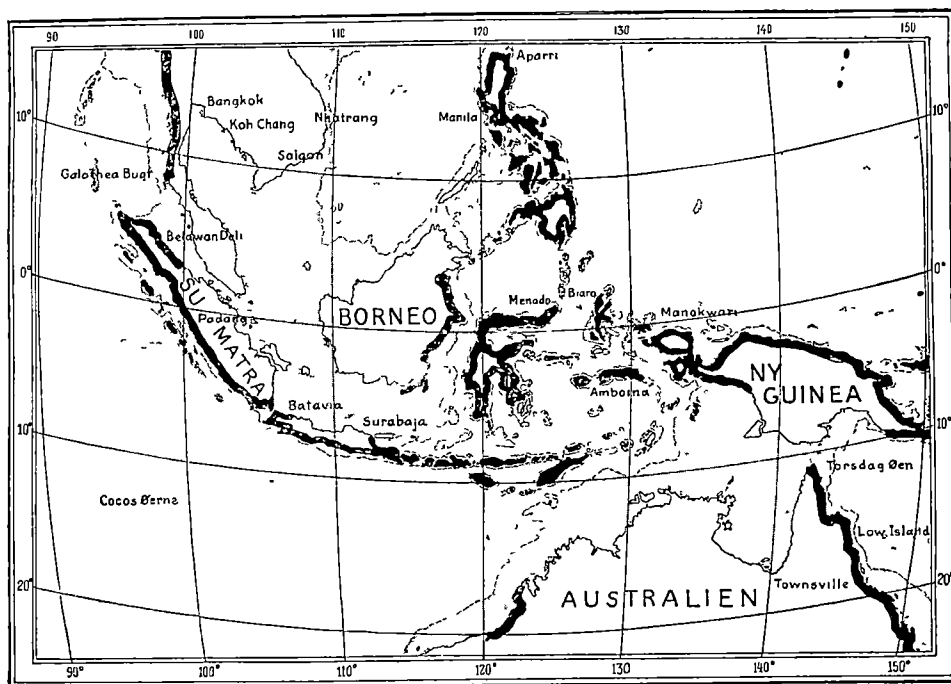


FIG. 3.—Distribution of eels in the Indo-Malayan Archipelago

he began as a botanist and that his field of research, quite apart from his exploratory work, has ranged from floras and the growth of hops to the variations of fish and fowls. This breadth of vision, so clearly displayed in his leadership, is supplemented by exceptional powers of concentration. We can discern both qualities in his review of the conditions in the Mediterranean, his eel investigations there have already been mentioned, his summary of the physical and biological phenomena is of equal significance.

From west to east in the Mediterranean the quantities of phosphates and nitrates, the substrata of organic life, decrease until in the Aegean the phosphates are entirely lacking and the nitrates less than 5 per cent of the quantity in the Atlantic. Presumably owing to the meagre precipitation of organic debris, the bottom fauna, evaluated by means of Petersen's bottom-sampler, was found to be exceptionally poor in the Gulf of Naples (0.5 gm per sq m), somewhat better in Algiers Bay (20 gm per sq m), and more like the conditions in

northern waters outside the Straits of Gibraltar (50 gm and more per sq m). Hard-bodied animals, Crustacea, corals and star-fishes, which have specialised in the utilisation of inorganic materials, are more or less strongly represented in the Mediterranean, but the soft-bodied animals, Mollusca, are deficient to a remarkable extent. This poverty of the waters and sea bottom of the Mediterranean gives an explanation of the dominant features of the piscine fauna, the scarcity of stationary species, the seasonal abundance of the migratory species, for example, of the herring and mackerel families, and the comparative absence of the gadoid and flatfish families, which form the chief marine food of northern peoples.

We obtain glimpses here and there also of other researches pursued by Prof Schmidt. For nearly twenty years now he has been carrying on an

intensive study of the races of fishes (eels, gadoids, *Zoarces*, etc.) and the causes of variation. In this pursuit, not content with the mere statement of variations in many thousands of specimens from many places, he has turned to direct experiment. The various theories connected with variation, heredity, natural selection, and the influence of environment have been tested by searching inquiry, and when the resources of the Carlsberg Laboratory proved insufficient for his purpose, he has made the waters round the Danish Islands, where the transitional conditions offer exceptional opportunities, his field of experimentation. These experiments, which fit in so well with his more general investigations, are approaching another milestone in their progress and seem destined to throw light not only on the causes and persistence of variations, but also on the origin of species. H M K

### Nikolaus August Otto, 1832-1891

AMONG the names of the hundreds of inventors through whose individual efforts the internal combustion engine has reached its present state of efficiency, that of Nikolaus August Otto will always be associated with the invention of the atmospheric gas engine and with the introduction of the four-stroke or Otto cycle for gas engines, which formed the subject of his German patent of Aug 4, 1877. Since then, the Otto cycle has been applied to internal combustion engines to an extent little dreamt of by the inventor, and it has proved of such fundamental importance that it may almost be compared with the invention of the separate condenser for the steam engine by Watt about a hundred years earlier. There are, it is true, many internal combustion engines running on the two-stroke cycle, but the vast majority of the millions of engines found in power-houses, factories, ships, motor cars, and aeroplanes to-day work on the four-stroke cycle.

Otto was born on June 14, 1832, at Holzhausen in Nassau, and died on Jan 26, 1891, at the age of fifty-eight years, at Cologne, where he is buried and where his centenary was commemorated on Tuesday last. The celebration was arranged by the Cologne section of the Verein Deutscher Ingenieure, and the address on the work of Otto, which was broadcast, was given by Dr A. Langen. To mark the occasion the Newcomen Society sent a chaplet with a suitable inscription, to be placed on Otto's tomb, in the Friedhof Melaten.

Otto's first occupation was that of a commercial traveller, and it was while engaged in business in Cologne that his attention was attracted to the gas engine. Considering it possible to make a gas engine capable of competing successfully with the steam engine, Otto began inventing, and through this was brought into contact with the engineer, Eugen Langen (1833-1895). On March 31, 1864, the two entered into partnership as N. A. Otto and Co., on April 21, 1866, they patented the vertical atmospheric gas engine with the free piston, and in the

following year exhibited one of their engines at the Paris Exhibition. The fuel consumption of this engine was far less than any of the French engines, and, thanks largely to their countryman, Prof Franz Reuleaux (1829-1905), one of the jurors of the Exhibition, the work of Otto and Langen was duly recognised.

This proved the turning point in the fortunes of the firm, for, encouraged by Reuleaux, the partners decided in 1869 to erect a factory at Deutz near Cologne, and in 1872 they formed the firm long since known as the Gasmotorenfabrik Deutz A.-G. At the same time, they secured the services of Gottlieb Daimler (1834-1900), the future inventor of the light spirit engine, and with him came Wilhelm Maybach (1846-1929), the future constructor of famous motor-car and aircraft engines. Otto now returned to his earlier experiments with engines working on the four-stroke cycle—a method of operation, it should be remembered, which was described in a pamphlet in 1862 by the Frenchman Alphonse Beau de Rochas. Success was achieved in 1876, the patent secured in 1877, and a four-stroke engine was exhibited at the Paris Exhibition of 1878. With this a new chapter in the history of gas engines began. Their manufacture was taken up by makers in various countries, notably in England by Messrs Crossley Brothers, and Otto gas engines soon became known all over the world.

Like many other persevering pioneers, no sooner had the Deutz firm achieved success than they found themselves drawn into litigation, and in the end the verdict was given against them and their patent declared void. But although it can be clearly shown that many of the ideas incorporated in the Otto engine had been previously thought of by earlier inventors, nothing can detract from the merits of Otto as the first to bring to fruition the valuable plan of operating gas engines on the four-stroke cycle. This alone will always secure for him a place among the greatest pioneers of the internal combustion engine. E C S

## Obituary

PROF MAX RUBNER

BY the death of Geheimer Obermedizinalrat Prof Max Rubner on April 27, the world has lost one of the most outstanding workers in the field of general nutrition. Rubner, born on June 2, 1854, belonged to the older school of workers who were interested in nutrition, for the most part, from its quantitative aspect, but although his greatest contributions to science were made in this field, even to the end he had also a lively interest in the qualitative side. A student in Munich, he became early in his career interested in the problems of metabolism and naturally gravitated to the laboratory of Carl Voit, becoming, after having spent a year in Ludwig's laboratory, one of his assistants and eventually Privatdozent (1883). In 1885 he was appointed to the newly founded chair of hygiene at Marburg as extraordinary professor, becoming *ordinarius* two years later. In 1891 he was called to Berlin to succeed R. Koch in the chair of hygiene there. This chair he retained until 1909, when he transferred to the chair of physiology in Berlin, vacant by Engelmann's death. This post he held until 1922, when he retired from active professorial work. He was Rector of the University of Berlin in 1910-11.

Rubner was undoubtedly one of the most energetic and stimulating workers in German biological science. In his early days with Voit he confined his attention to metabolic problems. It can be fairly stated that it was he who was mainly responsible for the application of the physical conceptions of Helmholtz and Mayer to biological material. Although he was not the inventor of the bomb calorimeter for the determination of the heats of combustion of foodstuffs, it was his research work in this field which established not only the crude but also the biological calorie values of protein, carbohydrate, and fat, which are accepted as international standards to-day.

Rubner's interest in the energetics of metabolism, begun in Munich, led at Marburg to extraordinarily fruitful research. It was during his Marburg period that he devised his ingenious animal calorimetric work, which enabled him to put forward his law of the specific dynamic action of foodstuffs and to give final and conclusive proof of his fundamental conceptions on the relation of the energy expenditure of an animal to its surface area. This period of his activity is reflected in his most original contribution, "Die Gesetze des Energieverbrauchs" (1902). This is undoubtedly a great but a very difficult book. It used to be said that there was only one man in Europe who could interpret it, and that was not Rubner himself but his friend and former Marburg colleague, Hans Meyer of Vienna. Rubner literally established the energetics of metabolism on a solid and lasting foundation.

Although his view of the work to be carried out by a professor of hygiene would seem at first sight to have been more of the nature of experimental physiology, Rubner did not neglect, particularly

after his translation to Berlin, the other aspects of his subject, as his many papers on public health subjects and finally his excellent textbook of hygiene (1907) attest. The range of his interests is simply astonishing, as is also the general high level of the material published.

Undoubtedly the subject nearest Rubner's heart was nutrition in the broadest sense of the term—nutrition as it concerned the people, its relation to growth, to general health. In addition to special sections on food in several large handbooks, he published several volumes of his own, for example, "Kraft und Stoff im Haushalt der Natur" (1909) and "Volksernährungsfragen" (1908), as well as numerous papers in the *Archiv für Physiologie* and other journals.

During the War years, Rubner played an active part in the working out of diets and the determination of the biological food value of various 'food substitutes'. Even after his retirement from his professorial chair, Rubner interested himself actively in the development of the Kaiser-Wilhelm Institut für Arbeitsphysiologie, Berlin (now in Dortmund). He was a member of many Government committees, and was for many years secretary of the Prussian Academy of Sciences, the *Sitzungsberichte* of which contain many of his interesting general papers.

E P C

MR R H ADIE

RICHARD HALIBURTON ADIE, of Trinity College, Cambridge, died on May 18, in his sixty-eighth year. To University, County, and Town he was for many years a familiar figure, and in their activities his work and personality were widely respected. It was the privilege of few to see so closely and for so long the development of agricultural education in Great Britain. In the first agricultural course held in Cambridge, commencing in 1891, Adie was a fellow-student of the late T. B. Wood and Cecil Warburton. His first appointment was as an extension lecturer in agriculture in Devon, which he relinquished to return to Cambridge. A small band, with vision and enthusiasm, had created the Cambridge and County Committee for Agricultural Education, and in 1895 he gave for them the first course of lectures in agricultural economics. Adie's initial studies had been principally in chemistry, and on returning to Cambridge he took charge of the chemical laboratory at St John's College. College teaching in chemistry continued until the outbreak of the War, and great numbers of men look back to the geniality and patience under which they began the study of chemistry in St John's.

The year 1899 saw the creation of a Department of Agriculture in the University. It was housed in two basement rooms of the University Chemical Laboratory, the head of which, the late G. D. Liveing, was its most valued friend. Resources were meagre, but the faithful service and remarkable versatility of the pioneer teachers laid foundations for the big developments which were to come.

Adie played an important part here as lecturer in agricultural engineering, surveying, and chemistry, and no less valuably in general development. Happily for the future of agriculture in Cambridge, his interest in civic matters grew rapidly at this time. By 1907 he was a member of the Cambridgeshire County Council, a body on which he served to the end of his life. He was also a member of the Cambridge Borough Council, becoming an alderman in 1914. In these early days, the financial support and the sympathy of the counties for agricultural education was of primary importance, and Adie's constantly growing influence in county administration enabled him to arouse among farmers and landowners a realisation of the part education could play in agricultural progress.

By 1914 the (then) Board of Agriculture scheme for advisory officers had been launched, and Adie became first secretary of the Provincial Council administering it. Throughout the War he was secretary of the Cambridgeshire Agricultural Committee. The School of Agriculture had to bear a full share of the sudden, heavy burden of reorganisation and pressure from students, brought by the cessation of war in 1918-19. It fell to Adie to lecture in engineering and surveying for both agriculture and forestry and in elementary chemistry and physics. In addition, he was secretary of the Special Board for Agriculture and Forestry, which, in its later form, the Faculty Board of Agriculture and Forestry, he served until his resignation in 1929. The lectures in agricultural engineering he continued to within a few weeks of his death.

Adie impressed his pupils by kindness, patience, and a *flair* for demonstration. His colleagues recognised in him a master of administrative procedure, a man of great stability, tenacity, and self-possession. To younger men, including those to whom by degrees he handed over his duties, he gave help, advice, and encouragement unsparingly.

#### DR H SEIDELIN

DR HARALD SEIDELIN, who died at Antwerp on April 29, was born at Aarhus (Denmark) in 1878, and studied medicine at the University of Copenhagen. In 1904 he went to Mexico, and became professor of pathology and bacteriology in the University of Yucatan, where his work was mainly concerned with investigations into the cause of yellow fever. He returned to Europe in 1910, and the following year joined the staff of the Liverpool School of Tropical Medicine as scientific secretary to the Yellow Fever Bureau. He took part in expeditions of the School to Yucatan and Jamaica to study yellow fever, vomiting sickness, and other obscure tropical diseases, and in 1912 he described certain minute bodies, found in the erythrocytes of yellow fever cases, which he believed to be the causative agent of yellow fever. He gave them the name, *Paraplasma flavigenum*, but his view of the parasitic origin of yellow fever was finally refuted in 1914 by Wenyon and Low. The last seventeen years of Dr Seidelin's life were devoted to the organisation and development of the medical service of the S A des Huileries du Congo Belge (Lever Brothers). Under his able and energetic leadership this service rose to a high state of efficiency, and he was honoured by the Belgian Government in 1929 with the decoration of Chevalier de l'Ordre Royal du Lion. Seidelin was a hard worker, a capable administrator, a careful investigator, and a brilliant linguist, speaking fluently half a dozen languages.

WE regret to announce the following deaths

Prof J W Gregory, F R S, emeritus professor of geology in the University of Glasgow, aged sixty-eight years

Prof A A von Jaczewski, director of the Phytopathological Institute in Leningrad, on Feb 12

### News and Views

#### New Associates of the Royal Astronomical Society

THE following have been elected associates of the Royal Astronomical Society. Prof Giorgio Abetti, director of the Royal Astrophysical Observatory at Arcetri, Florence, who is known for his observations on the chromosphere and on solar prominences, Prof R Emden, professor of physics, Technical High School, Munich, and author of "Gaskugeln" (1907), which consolidated and extended earlier work on the internal constitution of the stars, and has been the foundation of more recent work on this subject, M Ernest Esclagon, director of the observatories at Paris and Meudon, who in addition to astronomical work has carried out a gravity survey in south-western France, Prof H Ludendorff, director of the Potsdam Observatory, and in 1920-30 secretary of the Astronomische Gesellschaft, distinguished for his work on stellar spectroscopy, Prof P J van Rhijn, director of the Kapteyn Astronomical Laboratory, Groningen, Holland, author of numerous papers on the proper motions and distribution of the stars.

#### Franklin Institute Awards

THE following medals, among others awarded by the Franklin Institute, Philadelphia, were presented on May 18. Franklin Medals to Dr Ambrose Swasey, of Cleveland, Ohio, for his development of methods and his invention of appliances for making machines, tools, and instruments of the highest precision, of the design and construction of the mountings of many of the world's largest telescopes, and for his scientific vision in the establishment of the Engineering Foundation for the promotion of research and its application in the various fields of engineering, Dr P Lenard, of the University of Heidelberg, in recognition of a life's work devoted to fruitful research in physics, which has included the demonstration of cathode rays outside the generating tube and their effects, the discovery of the electronic nature of the emission from surfaces upon which ultra-violet light falls, as well as the basic laws of photoelectricity. Elliott Cresson Medals to Dr P W Bridgman, of the Jefferson Physical Laboratory of Harvard University, Cam-



bridge, Massachusetts, for his fundamental contributions to the technique of high pressure experimentation and to our knowledge of the properties of matter at high pressures, Mr C Le G Fortescue, of the Engineering Department of the Westinghouse Electric and Manufacturing Company of Pittsburgh, Pennsylvania, for the development of the method of symmetrical co-ordinates applied to the solution of poly-phase networks, Dr J B Whitehead, Dean of the Engineering School of Johns Hopkins University, Baltimore, Maryland, for his investigations of dielectric behaviour and allied subjects Howard N Potts Medal to Prof G P Thomson, of the Imperial College of Science, London, for his experimental demonstration of the wave properties of high speed electrons

#### Sir James Hall, Bt, 1761-1832

"AMONG Hutton's friends", wrote Sir Archibald Geikie in his work "The Founders of Geology", 'there was one in particular to whom a distinguished place in the list of the founders of geology must be assigned—Sir James Hall of Dunglass To this original investigator we owe the establishment of experimental research as a branch of geological investigation' The heir to a considerable estate at Dunglass, Haddingtonshire, Hall was born there on Jan 17, 1761, and died at Edinburgh on June 23, 1832—a century ago After three years travelling on the Continent, he married a daughter of the Earl of Selkirk and settled at Edinburgh, where he soon became familiar with the interesting group of men who made Edinburgh famous as a centre of scientific thought He was especially friendly with Playfair and Hutton, being greatly interested in the geological controversies of the time, and after opposing some of the views of Hutton, became one of his keenest supporters It was this that led him to make a long and laborious series of experiments on the fusion of various substances "These experiments", said Humboldt in *Cosmos*, "made more than half a century ago, together with the attentive study of the phenomena of granitic veins, have contributed in a very high degree to the recent progress of geological science" For many years Hall was a fellow of the Royal Society of Edinburgh, and at one time served as president. His bust was placed in the Royal School of Mines many years ago

#### Sir Prafulla Chandra Rây

WE have received from India some press accounts of the celebration organised by the Lahore branch of the Indian Chemical Society of the seventieth birthday of Sir P C Rây, who is well known as a chemist The great services rendered to India both in a scientific and national capacity by Sir P C. Rây were emphasised by the speakers His students have been active in furthering the cause of chemical science and education in India along the lines laid down by their teacher, and the foundation and growth of the Indian Chemical Society may be regarded as indications of the development of the methods which guided his activities in the promotion of chemical science in India. Sir P C Rây's experimental work is well known in Europe,

and his "History of Hindu Chemistry" is the only work of its kind in a European language The reports also lay stress on his excellent work in the relief of distress in India, and in encouraging and helping poor students in Bengal especially A portrait of Sir P C Rây was unveiled in the Library of the University Chemical Laboratory at Lahore, and a fund is to be started for the assistance of students In a communication from Calcutta, it is stated that a memorial volume of about 500 pages in English and native languages and dealing with several subjects is to be published

#### Calculating Machines and Scientific Investigation

A DISPLAY of calculating machines was arranged early this month by the Burroughs Adding Machine, Ltd, at 136 Regent Street, London, W 1 The machines shown were of many types, ranging from the simpler hand adding machines (which can also be used by the skilled operator for multiplication and division) to the complex electrically driven Calculating-Book-keeping Machine, which can be set up by adjusting a system of controls to carry out a variety of different automatic functions It is interesting to note that these machines, designed originally to deal with problems of costing and book-keeping, can be readily employed to simplify a great variety of computing problems. The mathematician, physicist, or statistician is often discouraged from attempting a problem involving the numerical solution of equations, the calculation of quadratures, or the forming of auxiliary tables, because of the apparently prohibitive amount of numerical computation involved It is possibly not generally realised, however, to what extent such work may be simplified and quickened up by the help of these modern aids to computing The machines are of course expensive, if needed only for occasional work, but the matter is really one for co-operation

WE are familiar with the importance of design in scientific experiment, design also is required in fitting a computing problem to a calculating machine, and the skilled designer in this field is already making a useful contribution to scientific investigation In the past a difficulty has been that the machine expert was unable to understand the problems of the mathematician, it is therefore interesting to learn that the Burroughs Company has realised the advantage of including trained mathematicians on its staff Another field for the adaptation of these machines is also in view There are signs both in Great Britain, in Germany, and in the United States of a growing interest in the development of scientific method in industry along the lines of statistical control of the quality of the manufactured product. Should the manufacturer begin to realise the function of statistical analysis in the problem of sampling and of testing and standardising material, he may require his calculating machine to provide him with standard deviations and coefficients of correlation If so, the machine makers should be ready to give advice on how best to proceed in this field, as well as in the problems of accountancy and costing

### The Joicey Collection of Lepidoptera

RECENT remarks by a learned and very senior judge in the Chancery Division, who was engaged in the hearing of a summons concerning the disposal of the very valuable collection of Lepidoptera formed by the late Mr J J Joicey, serve to direct attention to the extraordinary lack of knowledge of natural history matters prevalent even amongst those whom one is accustomed to regard as amongst the best informed. The judge in this case is reported to have said that "He had never been to the Museum since he was taken there as a boy, much to his discomfort, and he always thought there was too much to see. If the collection went elsewhere it might be seen to better advantage." The museum concerned in the case was the Natural History Museum. Should the judge even now, however, care to make amends, it is safe to say that he will be spared the horror of having to 'see' the Joicey collection should it eventually, as is hoped, find its way to South Kensington, for, as is common knowledge amongst naturalists, it is not the policy of the British Museum (Natural History) to display to the public collections of such great scientific value as this. Indeed, it would be impossible to do so in this case, for the 250,000 specimens involved would need a whole gallery (which is not available) for their accommodation. Surely it is time judges and others in high position ceased to express gratuitous opinions of the kind mentioned, which, in the long run, may do incalculable harm to the parties involved and, not least, to the respect in which the administrators of the law are normally held. Fortunately, in the case of Mr Joicey, the decision of the court, although it was not what it was hoped it would be, may still not prejudice the ultimate gift of his collection to the nation by the trustees of the estate of which it at present forms part.

### Waste in Education and Chemistry

PROF HENRY E ARMSTRONG is a provocative speaker whose observations in public are generally as pungent as they are pertinent, as a writer he excels in the art of garnishing a deal of common sense with a deal more of trenchant criticism. As a chemical criminologist Prof Armstrong has no equal, for many decades he seems to have watched his fellow chemists and educationists stray from the obvious path of rectitude and fall one by one into every kind of intellectual disgrace. Such unrivalled experience, together with the habit of fearless insistence on the importance of the most important things, serves to equip him admirably to play the double part of detective inspector and prison chaplain. On two occasions recently Prof Armstrong has said much that was well worth saying, and has added a good deal that, in our opinion, is more likely to diminish than to enhance the brilliance of his analysis. The first address, delivered before the Imperial College Chemical Society in January last, was entitled "Waste Chemistry", and the second, delivered before the London and South-Eastern Counties Section of the Institute of Chemistry in February, was entitled "Shifting Sands". Prof Armstrong detests waste—including most of the chemistry that is taught in schools and colleges. He

deplores waste of effort in the perpetual killing of the slain under the disguise of new jargons. There is considerable point in his stricture (provided it be remembered that it is one thing to kill a dragon but quite another to keep it dead), whether or not this waste of opportunity is "owing to a cultivated and obtuse narrowness of vision"—and he can have full marks for the debating point. But this is not all, in addition to being wasters, we have no sense of proportion and no ability to work problems out to a logical end. Again, all this is probably true in some degree of most of us and in greater degree of some of us.

STILL, the crimes alleged against the prisoner have not all been stated, according to Prof. Armstrong, our educational system is simply dishonest, being calculated to promote selfishness and to give employment to a maximum number of people, all bent, through their inability to think, on using their ignorance in misleading learners. A statement of this kind is purely provocative, and ought not to be made by Prof Armstrong or anyone else. It ignores a vast amount of unselfish and earnest educational service, and despises the efforts of thousands of men and women of at least average ability and usually possessing some sense of public duty and private responsibility. The educational army, nevertheless, will continue its march, whether or not Prof Armstrong is the only one in step. To return to the addresses, and to discover in them things worth recording. Prof Armstrong is undoubtedly right when he warns us that the nations cannot much longer allow the uncontrolled waste of natural resources to continue. Industry of every kind, he rightly says, must be controlled and organised with due reference to both raw materials and requirements, instead of being allowed to proceed, without thought of policy, merely as speculative, individual adventure. Emphasis is laid, too, on the relation of scientific discovery to the use of labour, and the attention of scientific people and employers of scientific people is directed to the need for discovering and directing labour-using rather than labour-saving occupations.

### Social Selection of Human Fertility

THE Herbert Spencer Lecture was delivered at Oxford by Dr R A Fisher on June 8 on "The Social Selection of Human Fertility". After recalling the consistent efforts of Spencer towards the unification of the natural and social sciences, Dr Fisher spoke of the hypothesis of complete determinism that has been held, as by Laplace, in the sphere of probability. From the course of physical investigation it might be plausibly conjectured that the mathematical formulæ, being often more accurate than the observational results, must more nearly represent reality, and hence that any fortuitous element can be excluded from physical phenomena. Researches, however, into the nature of the ultimate particles of gases do nothing to strengthen the deterministic position. The only principle on which the behaviour of a system can be predicted is that its properties are the average of a large number of independent items of behaviour. Human societies may be large enough

to show natural causation, where their constituents may be regarded as independently active. Limitations are imposed by organisation and by public opinion, but there are features of society which appear to be exempt from such limitations. These are (1) the hereditary endowment received by each generation, and (2) the individual reactions, though not the conditions, of what may be called the process of social promotion.

THERE is a presumption, Dr Fisher said, that at the present day social promotion depends more on intellectual superiority and less on business aptitude than it did, say, a hundred years ago. Though no occupational class is strictly endogamous, the differences produced by selection for occupational status tend to be perpetuated. An unintentional feature that has arisen in our economic system is that the highest forms of ability are united with relative sterility, and vice versa. Whether a similar process was present in past civilisations it is for historians and archaeologists to decide, but in regard to Great Britain "it is difficult to avoid the conclusion that a full half of whatever eugenic value this [fairly well-to-do] class contains may be counted as already lost." There is, Dr Fisher concludes, no ground for fatalism, but in considering the causes of an impending evil, we should as scientific workers distinguish between the inevitable and the avoidable, and as citizens we should in the latter case see to the application of the requisite control.

### Science and Philosophy

IN his recent presidential address to the British Institute of Philosophy, under the title "Philosophy and the Ordinary Man", Sir Herbert Samuel pointed out that although all action and thought is the conscious or unconscious product of a philosophical attitude, the ordinary man takes little interest in philosophy, with which he thinks he has no concern. In this respect philosophy contrasts strikingly with science, which arouses widespread interest. The reason is partly that expositors of science do not disdain to write in the vernacular, whereas many philosophers find it necessary to use a special terminology. It is chiefly, however, that science consists predominantly of a body of knowledge which commands common assent, whereas philosophy is largely an aggregate of individual systems of thought. Nevertheless, it has an important function to perform in constructing an authoritative code of morals for the guidance of those bewildered by the progress of science. It could best do this, said Sir Herbert, and at the same time command greater public interest, if it could be induced "to turn aside from *a priori* methods, to put no great faith in Logic as a guide, and to press forward into the realms of metaphysics and ethics along the roads opened up by mathematics, physics, biology in general and psychology in particular, and by the social sciences."

### The Principle of Causality

THE first principle which philosophy might receive, as established by science, is the principle of causality, which, in spite of recent attacks by some physicists,

still reigns supreme. In support of this contention, Sir Herbert Samuel quoted a letter from Einstein and the published opinions of Planck. The principle of causality leads in philosophy straight to a theistic position, for since the universe is not self-explanatory, there must be "something else." We cannot, however, at present fathom the nature of the Divine Mind. The principle of causality appears to deny human free-will, but although from a universal point of view this is so, events in the limited sphere of human action proceed as though our wills were free, and practical life must be conducted on that footing. A further application of the principle of causality in philosophy leads to a definition of the 'Good' as that which experience shows to promote well-being, rather than as an ideal standard of values. In the general adoption of the scientific method, philosophy will find its chief opportunity and its main strength.

### Harrison's Third Marine Timekeeper

OF special interest among recent additions to the Science Museum collections is the third of the series of four chronometers designed and constructed by John Harrison between the years 1728 and 1759, this instrument has been lent by the Lords Commissioners of the Admiralty. The British Government had in 1714 offered an award of £20,000 for an accurate method of determining longitude at sea. It was realised that the problem could be solved by carrying on board ship a trustworthy timekeeper, and Harrison set himself the task of constructing such an instrument, after devoting practically his whole life to the work, he succeeded in winning the award with his fourth timekeeper. Harrison's No 3 timekeeper is designed so as to be unaffected by the motion of a ship, while on account of the extensive use of friction wheels it requires no oiling, it also embodies original and ingenious methods of compensation for variations of temperature and of arc. The chronometers Nos 2 and 3 are now shown in motion side by side in the Science Museum, No 4 is at the Royal Observatory, Greenwich.

### Zoological Collections of de Sélys

MANY specialists on the systematics of the Vertebrata are under the mistaken impression that the famous collection made in the course of the nineteenth century by Michel Edmond de Sélys-Longchamps is either destroyed or lost. Happily this is not so. The collection was preserved in the Chateau de Longchamps près Waremmes, Belgium, where it occupied the little museum which de Sélys built, but it was not readily accessible to specialists and was in the care of an old servitor. The fate of this collection, which is a veritable treasure-house for mammologists and ornithologists, has just been settled in a way which will give widespread pleasure. Barons Maurice, Raymond, and Edmond de Sélys-Longchamps, grandsons of the great zoologist, have given the whole collection to the nation, and it is being placed in the Royal Museum of Natural History at Brussels. Thus all de Sélys' zoological collections are brought together again, for in 1900 de Sélys bequeathed his important entomological collection to the Museum.

### American Expedition to Northern India

SINCE the beginning of March an American scientific expedition sent out by Yale University has, under the leadership of Dr Hellmut de Terra, been doing geological and biological research in Northern India. Having visited the Salt Range, Dr de Terra and Prof G E Hutchinson, a biologist at Yale University, have proceeded to Kashmir, where they are making a geological and biological survey of the Kashmir valley. Ultimately they hope that this survey will make possible a clear understanding of the natural history of this southern Himalayan sector, from the pleistocene period to the present day. Another member of the party, Mr G E Lewis, fellow in palaeontology at Yale, has been collecting tertiary vertebrate fossils in the Siwalik formations of the Northern Punjab. On May 15 the expedition, accompanied by the surveying officer Khan Sahib Afraz Gul Khan, left Srinagar and started for the Eastern Karakorum, a field in which Dr de Terra has already done geological work while accompanying Dr Trinkler's Central Asia Expedition. Five months will be devoted to work in this region, which includes the still little known tract of land lying along the north-west Tibetan plateau. While the rest of the party will be busy with geographical and geological problems, Prof Hutchinson plans to carry out limnological studies on the great Pangong and adjacent lakes which are among the highest lakes in the world.

IN reference to the work of this expedition in the Salt Range, Dr L L Fermor, officiating director of the Geological Survey of India, writes from Calcutta to point out that a note in these columns (*NATURE*, Feb 20, p 275) on the plans of the expedition—which was based on an announcement issued by Science Service of Washington—"seems unjust to the Geological Survey", in suggesting that the Salt Range had not been examined systematically for palaeontological evidence. Dr Fermor directs attention to a number of contributions to the *Memoirs of the Geological Survey* and *Palaeontologica Indica*—on the geology by A B Wynne and Sir Edward Pascoe, and on the palaeontology by R Lyddeker, G E Pilgrim, W. Waagen, and others. In addition, Dr Fermor states that the Range itself is now being surveyed in great detail by E R Gee.

### Early Man in Palestine

FURTHER information relating to the human skeletal remains found in the Mousterian strata of the Palestinian cave, Mughareet es-Sukhul (see *NATURE*, May 14, p 712), as given by Miss D A E Garrod in a communication to the *Times* of June 11, indicates that the discovery is of even greater significance than at first appeared. Now that Mr MacCown and his assistants have been able in part to remove the breccia in which two of the skeletons were embedded, it is becoming possible to appreciate the bearing of certain incompatibilities with the Neanderthal type, which Sir Arthur Keith had noted in the Gahlee skull and other remains found in the Palestine caves in association with a Mousterian culture. These two

skeletons are practically complete and lie as they were buried, one on its back, the other on its left side with legs flexed and heels drawn up towards the sacrum. Although the skull has the characteristic powerfully developed supraorbital ridges, the cranial vault is higher and the head somewhat rounder than in Neanderthal man, while viewed from behind, the greater breadth appears nearer the base and the sides are comparatively straighter, converging slightly towards the top of the head. Even more remarkable is the facial skeleton, which appears to exceed in prognathism the most prognathous of Neanderthal skulls, giving it an ape-like appearance. The lower jaw is as heavy and as squarely built as in Neanderthal man, yet it has a decided chin. The limb bones are massive but longer than those of Neanderthal man, but it is evident that Palestine man walked with the Neanderthal slouch. In view of these facts, Sir Arthur Keith confirms the conclusion of the excavator that here we have a new race, or even a new species, of fossil man, for which Sir Arthur proposes the name *Palaeanthropus Palestinus*.

### Tornadoes in the United States

IN the *Monthly Weather Review* for last December there is a preliminary report on the frequency of tornadoes in the United States during 1931, on the number of deaths caused by them, and on the material damage. This report shows that in the past year tornadoes were notably scarce compared with other recent years, and did less damage than usual, also that, what is even more satisfactory, they caused less than half the number of deaths recorded in any of the previous fifteen years. Even so, the death roll, resulting from about ninety of these visitations, reached 34, of which no fewer than 14 occurred last December. The unit in which material damage is expressed is the sum of a thousand dollars, and in five months the total damage thus expressed ran into three figures, September was outstanding with 828,000 dollars' worth of damage caused by twelve or thirteen tornadoes. The figures for monthly frequency of occurrence of the storms show a characteristic early summer maximum, with a total of 32 storms in May and June, that is, of more than a third of the year's total. It may be noted that although the tornado and the commonest type of summer thunderstorm are probably both caused by local instability due to the juxtaposition of air masses of different temperature, of which the warmer generally carries a great quantity of water vapour, they must be regarded as in some way essentially different in their modes of origin.

### The Five-Year Plan in Russia

A SERIES of economic studies of Russian production under the Five-Year Plan is being published by the Bureau of Research of the Russian Department of the University of Birmingham, under the editorship of Prof S Kononov. No 5 deals with the economic results for 1931, agricultural collectivisation, and oil production and export. The statistical presentment of the plan is of much interest. As regards agriculture, it is shown that while the 1913 output of

cereals was 81.6 million tons, the average output in 1927, 1928, and 1929 fell to 72.9 million tons, or a decrease of 10.7 per cent. This, however, was increased in 1930, under collective farming, to 87.4 million tons, but the hopes for 1931 of 97.9 million tons fell short by as much as 21.5 million, which, with an annual growth of population of 2.36 per cent, has meant a cessation of export. The shortage would appear to have been largely due to vain attempts to increase too rapidly the area under cereals, which led to badly prepared soil, thin sowing, and delayed harvests. Less favourable weather was another cause. Nevertheless, the sown area of cereal and other crops has been increased during the last year by more than seven per cent. An analysis of the output of large scale industry shows an increase in the last year of 21.7 per cent, against the anticipated 44.3 per cent. At the same time, there are other negative results which are fully analysed in this report, such as the decrease in the productivity of labour, and the increase in cost of production and in prices.

#### Antirabic Treatment in India

THAT dread disease hydrophobia, caused by the bite of rabid animals, is of considerable importance in India, and 456 deaths were attributed to it in 1930 in the Madras Presidency. The report for 1930 of the Director, Major Iyengar, of the Pasteur Institute of Southern India, Coonoor, records that 541 patients were treated at the Institute, with 5 deaths, a mortality rate of 0.92 per cent. In addition, 4747 cases were treated at other centres in the Madras Presidency, with 5 deaths. Semple's carbolic sheep vaccine was used throughout, the virus being in its 1154th passage at the end of the year. Animals to the number of 229, including one elephant, were also treated, with no death. Bites treated were inflicted by eleven species of animals, including man, panther, leopard, jackal, and fox.

#### Investigation of the Atmosphere in the U.S.S.R.

A SCIENTIFIC institute has recently been established in Moscow to carry on research on the circumstances of formation of cloud, fog and rainfall. The institute has branches in Leningrad, Odessa, Saratov, Tashkent, and Ashkhabad. The Leningrad branch of the institute is installing apparatus for investigating the effect on the atmosphere of high-tension currents, X-ray, ultra-violet rays and radioactive radiations. It is hoped to test the apparatus next summer in experiments to be carried out in the drought regions of the U.S.S.R.

#### Announcements

At a congregation held at Cambridge on June 11, the honorary degree of Sc.D. was conferred on Sir William Bragg, director of the Royal Institution.

DR HENRY S. WASHINGTON, the distinguished petrologist of the Geophysical Laboratory of the Carnegie Institution of Washington, has been elected an honorary member of the Mineralogical Society.

PROF. H. E. ARMSTRONG will deliver the next Huxley Memorial Lecture at the Imperial College of

Science and Technology on May 4, 1933. Prof. Armstrong will speak on Huxley's educational creed and its outcome.

THE following committee has been appointed to inquire into the sterilisation of mental defectives: Mr L. G. Brock (chairman), Dr Wilfred Trotter, Dr R. A. Fisher, Dr A. F. Tredgold, Miss Ruth Darwin, Dr E. W. Adams, Dr R. H. Crowley, Dr E. O. Lewis, with Mr F. Chanter, of the Board of Control, as secretary. The terms of reference are: "To examine and report on the information already available regarding the hereditary transmission and other causes of mental disorder and deficiency, to consider the value of sterilisation as a preventive measure, having regard to its physical, psychological, and social effects, and to the experience of legislation in other countries permitting it, and to suggest what further inquiries might usefully be undertaken in this connexion."

THE reports of the destruction of a gaol at Mymensingh, in Bengal, on May 9 last, by a tornado, were probably incorrect in attributing the damage to a tornado, for the 'nor'westers' are quite capable of doing all the damage described on this occasion and are particularly frequent in May. These squalls, associated with early summer thunderstorms in Northern India, can be very violent.

A NEW catalogue (No. 549) of second-hand books and journals has just reached us from Francis Edwards, Ltd., 83 High Street, Marylebone, W.1. It comprises nearly 1700 works—many rare—dealing with folklore and anthropology.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in the Chemistry Department of the Heriot-Watt College, Edinburgh—The Principal, Heriot-Watt College, Edinburgh (June 20). A principal of the Walsall Technical College—The Director of Education, Education Offices, Council House, Walsall (June 25). A principal of the Chelmsford School of Art and Technology—The Director of Education, County Offices, Chelmsford (June 25). A lecturer in zoology (botany subsidiary) at the Chelsea Polytechnic—The Principal, Chelsea Polytechnic, Manresa Road, S.W.3 (June 30). A lecturer in the department of botany in the University of Durham (Durham Division)—The Head of the Department of Science, University of Durham, South Road, Durham (July 1). An F. W. Bennett lecturer in physics at University College, Leicester—The Registrar, University College, Leicester (July 5). A graduate assistant master to teach mathematics, with elementary science as subsidiary subject, in the Halifax Junior Technical School—The Principal, Municipal Technical College, Halifax. An assistant master for the teaching of painter's and decorator's work at the Huddersfield Technical College—The Director of Education, Education Offices, Peel Street, Huddersfield. A chief instructor in agricultural subjects at the Army Vocational Training Centre, Chisledon, Wiltshire—The Commandant, Army Vocational Training Centre, Chisledon, Wiltshire.

## Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

### The Inheritance of Acquired Characters

MR HALDANE professor of physiology in the Royal Institution, has adopted the unusual course of delivering an address in which he directly attacks a discourse which, at the request of the managers of the Royal Institution, I delivered a year ago, and an answer from me seems to be called for. Within the limits of a letter I cannot deal with what are in my opinion the fallacies in Prof Haldane's address, as to do so would involve writing another discourse. I shall have to confine myself to the cardinal points at issue, the more so as no one would have guessed from Prof Haldane's words either (1) what Lamarck really said or (2) what the argument in my discourse had been.

Briefly, then, my argument was this. Whenever we have evidence which enables us to determine with a probability amounting to practical certainty what the actual course of evolution has been we find that it presents the same features, namely, an extremely slow and continuous change of structure correlated with a corresponding slow modification of habit. Since changed habits, by exercising different parts of the body, do modify structure and since we know that animals can and do change their habits in response to the demands of a changed environment, it is a natural inference that the changed habits are the cause of the changed structure, and that the structural response of the individual has finally become engrained in the heredity of the race. So strong is the evidence for this inference, that some of my friends amongst the leading systematists of the British Museum deny altogether the necessity for direct experimental confirmation of it, arguing with probable justice that so many generations would be needed to make the change manifest that the time required would far exceed the span of an experimenter's life.

Lamarck did not, however, as Prof Haldane mistakenly suggests, suppose that external circumstances (that is, environment) produce a change which is afterwards produced by internal causes (that is, inherited). On the contrary, he stated explicitly that the environment produces *no direct modification of the animal whatever*. (Here he goes too far, there is little doubt that 'mutations' are produced by the direct action of the environment.) What modifies an animal, according to Lamarck, *is its own activity*. This activity, called forth by its needs in a new environment, *if it lasts for a long time*, eventually causes the formation of new habits, these in the long run lead to new structures and are reproduced in the young.

Now, the time at the disposal of an experimenter is only about five years, in very rare cases ten years, and it is too much to hope that in this brief time noticeable modifications of structure will be produced, but there is room for hope that new habits may be formed, and that these new habits may prove to have an influence on posterity. I pointed out that it would be entirely contrary to expectation to find that the new habit persisted when the offspring were replaced in the typical environment, at most we might expect an *intensification* of the habit when the

offspring were reared in the new environment, and a *lag* in the reversion to the parental habits when they were replaced in the typical environment.

These expectations, happily, have been fulfilled and I mentioned a number of experiments, three of which, I hold, afford conclusive proof of the influence of habit on posterity. These are (1) Durkhen's experiments in exposing the caterpillars of the white butterfly to orange light which suppressed the white colour of the pupal case and made the pupæ look green. When a second generation produced from these pupæ were reared in ordinary daylight, from 35 to 50 per cent were green. (2) Metalnikoff's experiments on the caterpillars of the beeswax moth, in which he inoculated some with a bacillus which proved uniformly fatal, whilst a control were inoculated with a vaccine which protected against the effects of the bacillus. Breeding from these immunised moths for several generations and inoculating each generation with the vaccine, he obtained a strain which were almost immune to the bacillus. (3) Heslop Harrison's experiments on the saw-fly, when he forced a saw-fly to lay its eggs on a plant to which it was not accustomed, and showed that in five years it had learned to prefer its new host plant to the old one.

If, as I think, every fair-minded person must admit on examining the evidence that these experiments are convincing, then the cardinal postulate of the Lamarckian theory is proved and we are free to apply it to explain the progress of evolution, and as a student of evolution all my life I can testify that the light which it throws on the process is amazing.

It is not surprising, therefore, that Prof Haldane attempts to explain away the results of these experiments, and he does this mainly by attributing them to selection. Now, though he claims to represent a new and insurgent group of younger biologists, his references to selection are evidences of an archaic type of thought. Selection as an effective cause of anything is a superstition which dies hard. That some animals live and some die is known to everyone, but unless the some that die differ from those that live, no change is produced. What a belief in selection really implies is that small inheritable variations in all directions are continually turning up *by chance*. The pure line experiments which Prof Haldane quotes were placed by me in the forefront of my arguments for Lamarckism, for they prove conclusively that such fluctuating deviations are not inherited, and hence they sweep away the main argument for Darwinism in its classical form. I am not alone in this opinion. In Germany these experiments have led to what is called "Der Krisis im Darwinismus".

Coming, however, to details. It provokes a smile to find Prof Haldane instructing Durkhen, who devoted five years to his experiments, what he must do in order to convince him, and asserting that there is not a shadow of evidence for anything more than selection. Durkhen carefully considered this point, and in later experiments put it to the test. He carefully selected the *darkest* of his pupæ (that is, the not-green), reared a second generation from them, which he exposed to orange light, and he obtained 96 per cent of green pupæ. There is no possibility, he says, of separating a green and a not-green race by selection.

The case for Metalnikoff is even stronger. Here according to Prof Haldane rigorous selection was used. This is an entire mistake, but I must admit that I did not in my discourse give a sufficiently clear account of these experiments.

Metalnikoff did not breed from the caterpillars which he had immunised and then inoculated with the bacillus. By preliminary experiments (which we



have repeated in my laboratory) he determined that the bacillus was uniformly lethal and that the vaccine afforded a constant immunity against it, then in each generation he immunised half the caterpillars and exposed half to the bacillus—but he always bred from the immunised half, and thus proved the cumulative action of the vaccine. Metalnikoff himself has no doubt as to the bearing of his experiments on Lamarckism, for in France, where he worked, the logical French mind has always clung to Lamarckism and has refused to be obsessed with the value of chance variations. Lastly, with reference to Heslop Harrison's experiments. Here again the argument for selection fails utterly, for the willow plant on which the saw-flies were forced to lay their eggs was a rare hybrid, and the supposition that Harrison was selecting an inborn 'gene' which conferred on the saw-fly larvæ the capacity to live on this plant is an hypothesis too fantastic for anyone except Prof. Haldane. As to the hypothesis of 'larval memory', which is at first sight a plausible one, it is untenable, because it assumes that the instinct of the mother to seek a certain plant and the capacity of the larva to live on this plant are inseparable. But Harrison by crossing two moths whose larvæ fed on different food plants obtained hybrids in which the mother sought the food plant of the paternal race but the unfortunate larvæ could only live on the food plant of the maternal race, and hence perished miserably.

Prof. Haldane makes a reference to my dead friend Kammerer. Let me then put on record that I believe that in time Kammerer will be completely vindicated, and this is the belief also of his teacher, Prof. Przibram. Kammerer was driven to suicide by the discovery that his type-specimens, the fruit of his life's work, had been tampered with and rendered useless. Whatever may happen in the future, one piece of Kammerer's work will endure, he succeeded in disproving for all time the hypothesis, endorsed by Prof. Haldane, that the blindness of cave-animals was due to their having by chance inherited eye defects—for in 1923 he produced in my laboratory large specimens of the blind cave-newt *Proteus anguinus* with fully developed eyes, evolved by exposing the animals at the proper stage of growth to the action of red light. This is the strongest indirect evidence yet adduced for the inheritability of the effects of disuse.

Finally, Prof. Haldane asks, "If we reject Lamarckism, what remains?" He answers, "Neodarwinism." The meaning of this term is doubtful. Certainly it signifies something which would not have been accepted by Darwin, for he remained half a Lamarckian all his life. I shall venture to define it as the theory of 'Chaos and Chance'. Certainly to anyone who accepts chance as an explanation, it is omnipotent and can be used to bridge any gap in the evidence. It is impossible to prove that a thing did not happen by chance, and the attitude which those of us who believe in regularity and law in this as in other departments of Nature must adopt towards the supporters of chance, is that recommended by Virgil to Dante concerning certain nondescript sinners whom they met at the entrance to hell, "*Non ragioniam di loro ma guarda e passa*."

The controversy between supporters of chance and habit as the cause of variation must ultimately be decided by the suffrages of biologists. I must say that I have been greatly cheered by the support which has reached me from all parts of the world, but I cherish particularly the memory of one incident. It is just fifteen years since I delivered my first lecture on this subject to a scientific society. I had the honour of having amongst my audience several distinguished scientific men, of whom one was the eminent physiologist, Prof. J. S. Haldane. After the lecture, I was

complaining to him of the prejudice which had to be conquered in order to persuade people of the inheritability of habit. "Well," he said, "one thing is certain unless it is true, there has been no evolution." With this opinion I cordially agree.

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### Origin of the Coronal Lines

In two recent communications<sup>1</sup> de Bruin has given a group of numerical relations, which relate the strongest visible lines of the corona, 5302.78, 6374.28, 6704, and 6775.90, with certain lines of the O I spectrum. According to de Bruin, there exist in addition to the following well-known deep-lying O I terms  $^3P_{1,2,3} = 109,831, 109,672, 109,605$ ,  $^1D_2 = 93,962$ ,  $^1S_0 = 76,037$ , another group of deep-lying terms  $P, Q, R, X, Y, Z$ , 94,925.1, 94,905.3, 94,898.7, 79,221.7, 78,946.2,

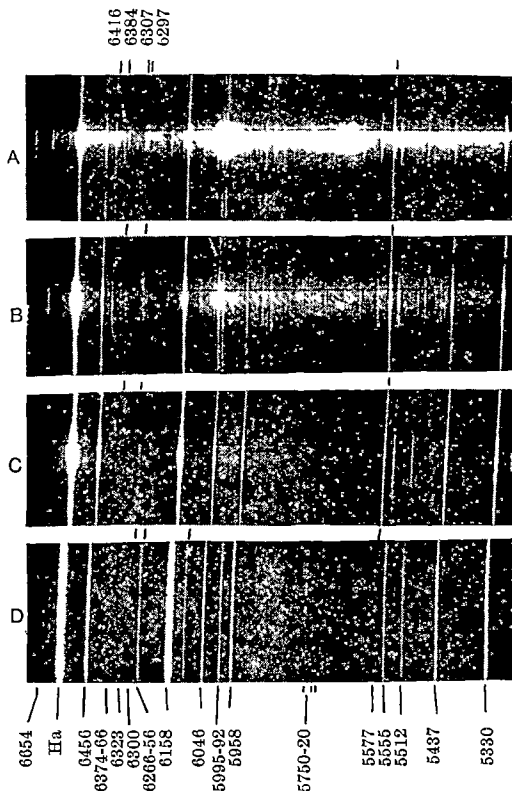


FIG. 1.—Spectra of argon and oxygen. Argon lines marked above, oxygen lines below the spectra.

78,932.3. The intercombinations of these new terms one with another and with the already known existing deep terms,  $^3P, ^1D_2$ , and  $^1S_0$ , are supposed to give the hitherto unclassified corona lines 6775.90  $2p\ ^3P_1 - P$ , 6704  $2p\ ^3P_2 - P$ , 6374.28  $Q - X$ , 5302.78  $R - 2p\ ^1S_0$ , as well as some unclassified lines of the O I spectrum 6654.12  $Y - ^1D_2$ , 6366.28  $P - X$ , 6374.29  $Q - X$  (it has been suggested by Hopfield<sup>2</sup> that the last mentioned line is identical with the coronal line 6374.28), and 6266.69  $-(P, Q, R) - (Y, Z)$ .

The theoretically expected scheme for the deeper terms of O I has been completely observed and verified previously<sup>3</sup>, unknown higher terms of the configurations  $s^2p^3$  and  $sp^4$  are only to be expected with

negative term values. The question therefore arises as to whether the admittedly exact numerical relationships given by de Bruin have a true physical meaning or whether they are purely accidental, as in previous unsuccessful attempts correlating coronal lines with other spectra. Since, according to de Bruin, these suggested new terms lie very deep, it should be possible to prove their existence by determining experimentally whether they do all actually lie deep. The photographs (Fig. 1) show the part of the O I spectrum under discussion with different degrees of excitation. *A*, *B*, and *C* were taken with a wide discharge tube (3 cm bore, 60 cm long, 0.8-1.2 amp d.c.). *A* shows the spectrum given by argon which contains very small traces of oxygen. In this photograph appear the strongest lines of the quintet and triplet systems and also the green auroral line 5577  $^1S_0 - ^1D_2$  and also perhaps (between the argon lines 6296.8 and 6307.7) the line 6300.03 (according to Paschen,<sup>4</sup>  $2p\ ^3P_2 - 2p\ ^1D_2$ ). *B* is given by a mixture of a few millimetres of argon and a little more oxygen than previously. The auroral line appears now with great intensity, and in addition the lines 6300 and 6364 (according to Paschen,  $1c$ ,  $2p\ ^3P_1 - 2p\ ^1D_2$ ) are also fairly strong. Further, this photograph and all the others show the strongest lines of the triplet and quintet systems, which can be explained by cumulative processes of excitation. The weak line 6391.0 ( $2p\ ^3P_0 - 2p\ ^1D_2$ ), the third classified by Paschen, is not observable.

It is a remarkable fact that not one of the supposedly classified lines of de Bruin appears with this excitation, although the strong intensity of the auroral line shows that any deep terms greater than 76,037 must also be excited in this discharge. Photograph *C* is taken with pure oxygen of a few millimetres pressure. The energy of excitation is displaced to higher values, the lines 5577, 6300, and 6364 become weaker relative to the other series lines, but the group 6266-56 just begins to be visible on the original plate. The last photograph, *D*, was taken with 0.8 amp d.c. in a narrow quartz capillary tube of 2 mm bore.

According to my earlier observations,<sup>5</sup> this mode of excitation is peculiarly suited for the production of highly excited terms. In this case the maximum of excitation is now displaced to larger values, thus 5577 is very weak, and 6300 has disappeared.

In contradistinction, all the following lines of de Bruin, 6654, 6374, 6366, 6266-56, as well as the other highly excited lines (5995-5991, upper term = -20,135.2 to -20,142.8 according to de Bruin, 5750-5720, upper term -13,458 to -13,548 according to Frerichs), show considerable intensity. The fact that de Bruin's supposed combinations between deep terms give lines which only appear when the energy is sufficient to excite high-lying terms (negative) proves unambiguously that these lines must involve high-lying terms and not deep ones. It is of interest to note that Paschen and Hopfield,  $1c$ , who used a discharge tube with dimensions between those giving spectra *C* and *D*, actually obtained a spectrum intermediate between that of *C* and *D*.

The present experiments prove definitely that amongst the lines considered only 5577, 6300, and 6364 are lines of deep excitation. Hence the degree of accuracy of wave-length agreement between coronal and oxygen lines does not then come into the question. It therefore appears that the numerical

relations of de Bruin are merely accidental, so that the great mystery of the coronal lines remains unresolved.

R FRERICHS

Physikalisches-Technische Reichsanstalt,  
Charlottenburg, May 15

<sup>1</sup> NATURE, 129, 468, March 26, 1932, *Naturwissenschaften*, 20, 268 1932

<sup>2</sup> Phys. Rev., 37, 160, 1931

<sup>3</sup> R. Frerichs, *Phys. Rev.*, 36, 398, 1930

<sup>4</sup> Z. Phys., 65, 1, 1930

<sup>5</sup> Phys. Rev., 34, 1239, 1930

THE interesting letter of Dr. T. L. de Bruin on this subject<sup>1</sup> throws additional light on the spectrum of neutral oxygen, and is very suggestive in relation to the hitherto unexplained spectrum of the solar corona. It appears, however, to be premature to conclude that the coronal lines—in particular the green line at 5303—have now been identified. An analysis of the evidence submitted by Dr. de Bruin shows that the suggested interpretation of the green line rests on the existence of the term *R*, the reality of which can be established only by assuming a classification of his groups I and II of oxygen lines, which is not the most satisfactory that could be made. The oxygen lines in question are the following:

| Group I              |          | Group II             |          |
|----------------------|----------|----------------------|----------|
| $\lambda$ (m $\mu$ ) | $\nu$    | $\lambda$ (m $\mu$ ) | $\nu$    |
| 6654.121 (4)         | 15024.14 | 6266.692 (1)         | 15952.97 |
| 6374.292 (5)         | 15683.68 | 6264.346 (2)         | 15958.95 |
| 6366.282 (4)         | 15703.42 | 6261.314 (5)         | 15966.68 |
|                      |          | 6258.965 (1)         | 15972.67 |
|                      |          | 6256.616 (3)         | 15978.67 |

de Bruin's classification is as follows, the numbers in brackets indicating the differences between the observed values of wave-number and those calculated from his terms:

|                    | <i>P</i>       | <i>Q</i>       | <i>R</i>       | $2p\ ^1D_2$   |
|--------------------|----------------|----------------|----------------|---------------|
|                    | 94925.1        | 94905.3        | 94898.7        | 93970.3       |
| <i>X</i> = 79221.7 | 15703.4 (0.0)  | 15683.6 (+0.1) |                |               |
| <i>Y</i> = 78946.2 | 15978.9 (-0.2) | 15959.1 (-0.1) | 15952.5 (+0.5) | 15024.1 (0.0) |
| <i>Z</i> = 78932.3 |                | 15973.0 (-0.3) | 15966.4 (+0.3) |               |

It is possible, however, to arrange the lines thus:

|                     | <i>P</i>         | <i>Q</i>         | $2p\ ^1D_2$   |
|---------------------|------------------|------------------|---------------|
|                     | 94924.92         | 94905.20         | 93970.3       |
| <i>X</i> = 79221.51 | 15703.41 (+0.01) | 15683.69 (-0.01) |               |
| <i>W</i> = 78952.24 | 15972.68 (-0.01) | 15952.96 (+0.01) |               |
| <i>Y</i> = 78946.24 | 15978.68 (-0.01) | 15958.96 (-0.01) | 15024.1 (0.0) |

This accounts for one line fewer than de Bruin's classification (a decidedly stronger line than its neighbours, and one which might well be unconnected with them) but demands one less term, so that on grounds of economy of assumptions, it is to be preferred. Furthermore, it agrees throughout with measured values of wave-length to within less than 0.004 Å, whereas de Bruin's classification involves errors of more than 0.1 Å in lines measured by Frerichs to the nearest thousandth of an angstrom. If the classification suggested here is the true one, there is no reason to suppose that the term *R* exists, and consequently the green coronal line remains unexplained. Further exact measurements of the oxygen lines in question would settle the point, and are much to be desired.

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May 25

<sup>1</sup> NATURE, 129, 468, March 26, 1932

### The Oldoway Human Skeleton

WE are glad to find from Dr Leakey's letter in NATURE of May 14 that he is in agreement with us in regarding the Oldoway skeleton as an artificial burial, and regret that, in common with everyone else whom we have consulted in this matter, we interpreted his original letter in NATURE of Oct 24 to mean that it was naturally deposited without human agency in Bed 2.

With the recognition that it was buried by man, the discussion of its date rests on a series of hypotheses and presumptions which, even at their best, can never give a certainty comparable with that given by a natural deposition.

So far as can be discovered from published sources, the skeleton lay embedded in Bed 2 below a sloping surface dipping down toward a stream course. Bed 2 at the site of the interment was not, when Prof Reck began his work, covered by Bed 3, which had presumably formerly extended over it but had been removed by erosion. Dr Leakey now claims that the skeleton was buried in Bed 2 before Bed 3 was deposited over it. This involves the supposition that the deposition of the materials of Bed 2 took place in water so shallow that a bedding plane was at one time exposed to air and sufficiently dried to allow men to walk over and dig a grave in it.

We know of only one line of evidence which could give certainty of the occurrence of such a condition, and should be glad to hear Dr Leakey's reasons for believing that it has occurred.

Granting this fundamental postulate, we have to consider the evidence that the grave was not dug in comparatively modern times. Dr Leakey claims that at a time less than fifty years ago the site of the burial was covered by an extension of Bed 3, and that hence, unless the burial took place before Bed 3 was deposited, or less than fifty years ago when Bed 3 was removed, some material of Bed 3, which differs markedly in colour and texture from Bed 2, must have been included in the grave infilling.

Dr Leakey, however, has shown that some survey pegs inserted by Prof Reck in 1913 were still *in situ* in 1931, so that the rate of denudation is demonstrably slow. Thus Dr Leakey's estimate of fifty years implies that the natural surface above the grave of the Oldoway skeleton lay only a few inches below the base of Bed 3. It is clear that an estimate of so small a thickness could only be made if the surface of Bed 2 on which Bed 3 rests is exceptionally plane, and if an elaborate series of levels had been made at the time of the original discovery before the land surface was destroyed. We understand that in fact Bed 2 is merely represented by *remanié* materials in the neighbourhood of the skeleton. It is thus extremely doubtful if it would be possible to make any sufficiently accurate measurements to justify Dr Leakey's estimate of fifty years. But in any event, the rate of denudation under the conditions existing at Oldoway must vary so greatly from yard to yard, falling probably to nothing where there is any protection afforded by vegetation, that the period required could not be estimated even if the data as to thickness were established.

The photographs published by Prof Reck show that the whole of the upper and a good deal of the lateral surfaces of the skeleton were exposed during the excavation made for its removal, and it is hence probable that Prof Reck removed it and a pedestal of the rock on which it rested by the ordinary method of hardening and bandaging. It need scarcely be pointed out that the only material certainly of the grave infilling carried to Munich in this way is that

which is contained within the ribs and between the limbs and the trunk, and that this was the first earth to be thrown back again into the grave.

The material of Bed 3 as it exists in a *remanié* form in the neighbourhood of the grave seems to consist of small calcareous nodules of varying hardness stained red with ferric hydrate. It is quite conceivable that their colour might be materially altered by contact with a decaying body. If the thickness of Bed 3 penetrated in the grave was small in proportion to that of Bed 2, the admixture would be small in any case, and the whole of the materials of Bed 3 excavated might be so completely covered during removal by those of Bed 2 that when this soil was shovelled into the grave, it is possible that the whole of the Bed 3 materials might be included in the mound above the surface and none reach the bottom of the pit. Thus although the discovery of a single fragment of Bed 3 in the grave infilling would show that the grave was dug through this bed, the absence of such a fragment does *not* show that the pit did not pass through it.

It is evident that the grave infilling which remained in the block when it was sent to Munich only represents a small proportion of that which filled the whole grave, and as the skeleton was still undisturbed when Dr Leakey examined it in 1925, it is clear that the proportion of the total volume of the grave infilling which he saw was minute. It is, furthermore, a universal experience that the appearance of a mass of rock is greatly altered by the process of hardening and bandaging, and, as we have pointed out, mere proximity to a large decaying body often alters the character of a matrix. Thus we feel that Dr Leakey is rash in stating that there is no trace of Bed 3 in the grave infilling.

If Dr Leakey be held to have established that the grave of the Oldoway man was not dug through Bed 3, he has still to show that it cannot have been dug during the period which has elapsed since the removal of Bed 3 took place. We have already shown that his estimate of fifty years is a guess, owing to the lack of adequate data as to thickness and to the variable rate of denudation from place to place.

Dr Leakey's evidence that the bones of the skeleton seem to be as much mineralised as the others in Bed 2 is of no great value. The specimens now in the Natural History Museum from this bed vary immensely, from bones easily powdered between the fingers, to others which are hard and brittle. No one can ever say how long it takes any bone to reach any particular physical or chemical state.

The only other evidence which Dr Leakey advances is that the anatomical characters of the skeleton cannot be matched amongst the local natives. But we understand, though we have not seen their work, that Messrs Gieseler and Mollison, who have recently described the remains, point out resemblances to the Masai who still inhabit the district.

It is thus apparent that the evidence Dr Leakey has so far adduced in no way excludes the supposition that the Oldoway skeleton represents a burial of relatively recent date.

The remainder of Dr Leakey's letter in NATURE of May 14 has no relevance to the particular problem of the age of the Oldoway burial, which is the only one with which we are concerned.

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### The Shedding of Certain Fibres in the Coat of the Lamb

In his letter<sup>1</sup> in *NATURE* on *Ovis astore*, Prof A F Barker discusses the shedding of certain fibres by domesticated sheep. As he points out, the shed fibres are usually regarded as representatives of the outer coat of wild sheep. The persistent fibres, of indeterminate growth, are looked upon as derivatives of the ancestral under-coat of wool. It is believed that the fibres of this under-coat, instead of ceasing to grow after a few weeks or months, and later being shed, have taken to maintaining their growth for a very much longer time, often probably throughout the natural lifetime of the animal.

While these generally accepted ideas concerning its ancestral history form the background of our thinking about the biology of the fleece, the present purpose is to point out the need for thinking of shedding and non-shedding in terms of physiology as well as phylogeny. In studies of the fibre types of the New Zealand Romney and their life histories, the attempt to explain the detailed observations made has led to speculations about differences in the activities of the follicles that determine whether a fibre ceases to grow and is succeeded by another, or whether the same fibre grows continuously. The present discussion is based mainly upon work on the region of the middle line of the back near the level of the last rib.

In the New Zealand Romney lamb the structural differences between the collection of birthcoat fibres that cease growing at about two months and those of persistent growth appear to be much less sharply defined than the differences between the fibres of the outer and the inner coats of wild sheep or of the Black-headed Persian<sup>2</sup>. In kempy lambs the biggest fibres present at birth are well-nigh certain to be shed, while many of the smaller types are sure to persist. In between come several types, covering a considerable range of characterisation, and taken together numerically important, that may or may not be shed. Which fibres are shed and which persist is clearly determined by orderly forces.

For many fibres it does appear that the balance may easily be tipped one way or the other towards shedding or persisting. In an earlier communication<sup>3</sup> it was stated that the proportion of sickle-fibres shed varies greatly from lamb to lamb. When many persistent sickle-fibres are present that resemble quite closely, in their apical structural details, some which are shed, it is a common thing to find some of these persistent sickle-fibres with a very marked thinning for half an inch or so below the point corresponding to the base of the shed fibres, while below this thinning the fibre becomes coarse again. Other persistent sickle-fibres, but little dissimilar apically from the last, continue comparatively coarse throughout what is evidently a critical time in the activities of the follicles of many sickle-fibres. It is believed that amongst fibres that will continue their growth for some weeks after birth, the earlier a fibre starts its development the greater its chance of ceasing to grow at about eight weeks, except in so far as the follicle is affected by the kind of birth check, a phenomenon to which reference was made in the earlier communication. It would appear that follicles which are well established before the birth check becomes powerful tend to shed their fibres, and that fibres grown in follicles founded just late enough to miss the force of the check are also more likely to be shed than those that have to face the intensity of the check at a very early stage of growth.

Wide variations from lamb to lamb are found in the proportion of shed and persistent fibres of several types, and it is possible to go a good way in generalis-

ing about the structural differences between shed and persistent fibres classified as of the same main type. The facts of the case seem to fall into line if we suppose simply that, in those follicles in which growth ceases for a time, fibre material has at some post-natal stage of development been elaborated at a greater rate than in those follicles where growth continues without interruption. In other words, if the follicle overworks, it is compelled to take a rest, and growth comes to a stop.

It is hoped shortly to publish the detailed evidence upon which this suggestion is based. Attempts are being made to test this explanation in various ways. The present purpose, however, is not to argue for the correctness of a particular working hypothesis, useful though it is proving. It is desired rather to show the kind of outlook upon shedding that results from a study of the details of structure and development of the lamb's coat.

The simple fact that mammalian hair grows only at the basal end invites fuller exploitation. Each fibre is an autographic record of a series of events in the follicle. Often enough portions of the curve traced by a fibre are suggestive of shorthand symbols. A better understanding of the code would enable us to decipher illuminating messages on many a biological question.

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<sup>1</sup> *NATURE*, 129, 128, Jan 23, 1932

<sup>2</sup> Duerden and Boyd, Union of South Africa Department of Agriculture, *Bull* No 82, 1930

<sup>3</sup> *NATURE*, 127, 482, March 28, 1931

### Attack of Oxygen Molecules upon Highly Crystalline Graphite

THE accompanying photographs (Fig 1) illustrate an observation made while studying the oxidation of graphite. A thin flake of Ceylon graphite (99.9 per cent carbon) was oxidised during many hours at 900° C in a stream of oxygen at 1 mm pressure.

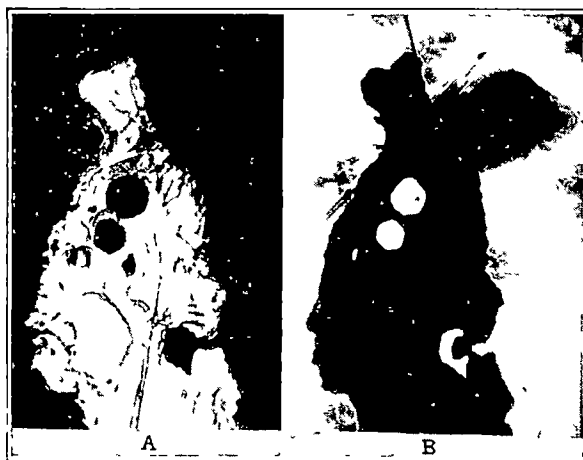


FIG 1—Crystalline graphite during oxidation ×140

(The product is about 50 per cent carbon dioxide and 50 per cent carbon monoxide.) Photomicrographs were taken at intervals, the two reproduced show the state of the flake when probably more than four-fifths of the original graphite had been oxidised away. In both, the flake is viewed, roughly, perpendicularly to the cleavage plane, A by light reflected from this plane, B by transmitted light.

There are two interesting features (a) The power of brilliant reflection at the appropriate angle from the

surface of the flake remains unimpaired throughout the oxidation, there is no pitting of this surface. Apparently carbon atoms are removed layer by layer. (b) The holes which eventually appear in the flake have a well-defined hexagonal form, which they retain as they grow, although when they reach the size shown, the corners begin to round off a little, when smaller, the hexagon appeared very regular. (Unfortunately, the reproductions appear more distorted than the original photographs, themselves imperfect.) The shadows round the flake in Fig 1, B, are caused by semi-opaque patches in the silica pan carrying the flake. It will be noticed that corresponding sides of the two clearly formed hexagons are parallel.

Possibly the formation of these holes is caused in the first place by the presence of minute inclusions of impurity, such as iron or an alkali metal salt, which would catalyse the oxidation of the carbon with which it is in contact. But the subsequent growth of the hexagons provides a manifestation of the influence of lattice symmetry upon the course of a chemical reaction. It seems to us that the points (a) and (b) are of interest in connexion with the mechanism of the oxidation of graphite.

E N GREER  
B TOPLEY

The Sir William Ramsay Laboratories of  
Inorganic and Physical Chemistry,  
University College, London, W C 1,  
May 12

#### Oxidation of Strychnine

I HAVE been studying the action of oxidising agents on strychnine for some time. Leuchs<sup>1</sup> stated that he had obtained an acid with the formula  $C_{21}H_{22}O_4N_2$  from strychnidine by means of oxidation with chromic acid. The acid is stated to crystallise from water in brown needles that do not melt up to 320°, and are nearly insoluble in alcohol and acetone, but readily soluble in ammonia, *N*-hydrochloric acid, and acetic acid. The acid in question gives crystalline precipitates in needles and prisms with nitric and hydrobromic acids, and amorphous precipitates with hydriodic and perchloric acids, which then become crystalline scales.

It appears that Leuchs<sup>2</sup> obtained this same compound by oxidising tetra-hydro-strychnine with large quantities of chromic acid in a carrier acidified with sulphuric acid, and Wieland admits that the high melting point of this compound shows<sup>3</sup> that the acid  $C_{21}H_{22}O_4N_2$  is a diphenyl derivate, to which he attributes, with more probability, the formula of  $C_{42}H_{42}N_4O_8$ .<sup>4</sup>

I would like to point out that by oxidising strychnine with chromic acid in a carrier acidified with acetic acid, I have obtained a crystalline compound in very shiny prisms, which melt at 309°-310°, and are soluble in alcohol and chymol when hot, but practically insoluble in water and all organic solvents, especially chloroform.

The reaction of this compound is neutral with litmus paper, and it gives strongly the colour reactions of strychnine. The product in question is obtained with several processes, and analysis gave the following results.

Microscopic analysis gave the following percentages

Carbon— 68.77, 68.69, 69.07, 68.58  
Hydrogen— 5.68, 5.65, 5.61, 5.53  
Nitrogen— 7.31, 7.38, 7.85, 7.75

Macroscopic analysis gave the following percentages

Carbon— 68.99, 68.86  
Hydrogen— 5.75, 5.88  
Nitrogen— 7.40

These results agree both with a formula of

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$C_{21}H_{20}N_2O_4$  and that of  $C_{42}H_{42}N_4O_8$ , and they seem to me to be interesting, since I am of the opinion that this is the first case in which a product has been obtained from the oxidation of strychnine that has the same number of atoms of carbon as that of the alkaloid itself.

Fuller details regarding this question will be sent later to the *Gazzetta Chimica Italiana*.

BERNARDI ALESSANDRO

Istituto Chem. Farm.,  
R. Università,  
Bologna, March 29

<sup>1</sup> Ber., 63, 2215, 1930

<sup>2</sup> Ber., 63, 3184, 1930

<sup>3</sup> Lieb. Ann., 491, 111, 1931

<sup>4</sup> Ber., 65, 201, 1932

#### The NO<sub>3</sub> Frequency in Organic Nitrates

THE characteristic inactive frequency at 9.5  $\mu$ , corresponding to a wave-number shift of 1050  $cm^{-1}$ , while it appears as a strong Raman line in the scattered spectrum of all inorganic nitrates examined both as crystals and in solutions, is not represented at all in the Raman effect of the organic nitrates. This is probably due to the influence of the CH group on the oscillations of the NO<sub>3</sub> ion. However, in alcoholic solutions of these organic nitrates this line comes out significantly, the intensity of the line depending upon the solvent used and also upon the concentration of the solution.

In the scattered spectrum of methyl nitrate (pure liquid), in addition to the CH frequencies, the observed Raman lines correspond to  $\nu_5$  583, 662, 866, and 1290, all of which are quite strong. These shifts, which are simple in methyl nitrate, are each split up into two or more components in the spectra of the higher alkyl nitrates, and also there is a considerable change in their intensities. In a twenty per cent solution of methyl nitrate in methyl alcohol none of these lines comes out, but instead we get a strong line at  $\nu_{23}$  665  $cm^{-1}$  which is excited by  $\lambda$  4047 of the mercury arc and corresponds to a shift of 1040. An equimolecular solution of amyl nitrate in amyl alcohol shows this shift only as a very faint line.

In this connexion it may be mentioned that the dielectric constant of methyl alcohol is very high, coming next to water, with a value 35, while for amyl alcohol it is only 16. We have studied the behaviour of this shift with dilution and there is a general tendency for the line to increase in intensity as the dilution increases up to a certain limit. A more detailed account of the investigation appears elsewhere.

A S GANESAN  
V N THATTE

College of Science, Nagpur, India,  
April 28

#### A Displacement in the N Lines of Tungsten and Tantalum

WE have recently conducted some experiments on the characteristic radiations of various elements in the extreme soft X-ray region. Spectra have been obtained with the aid of a vacuum spectrograph employing a plane Siegbahn grating in the grazing incidence setting. Using a water-cooled anti-cathode, on to which tungsten was sputtered from the hot filament of the X-ray tube, we have obtained lines at 55.58 and 58.42 Å. Thibaud and Soltan<sup>1</sup> have previously obtained wave-lengths of 56.0 and 59.1 Å, while Prins,<sup>2</sup> who, in addition to using this procedure, has apparently employed a water-cooled tungsten anti-cathode, has recently published values of 55.7 and 58.4 Å, with which our results are in good accord.

Using an anti-cathode of tungsten sheet, allowed to become incandescent, we find that the lines are displaced. The wave-lengths are now 55.29 and 58.09 Å respectively. This represents an increase in the corresponding energies of 1.2 electron volts for each line.

The short wave-length line (55.58 Å) may be safely attributed to a transition ( $O_{IIIII}$  to  $N_{IV}$ ) and the long wave-length line (58.42 Å) to ( $O_{III}$  to  $N_V$ ). The energy shift obtained when the tungsten is hot being the same for both lines, it is natural to suppose that it is due to a change in the common initial state. This is to be expected, since the final  $N$  levels are relatively deep within the atom. We thus arrive at the conclusion that the  $O_{IIIII}$  level is 1.2 volts deeper for the cold tungsten than for the hot.

The shift of the  $O_{IIIII}$  level may be explained either by assuming that the crystal structure is different in the two cases, or by supposing that there is a difference in the chemical state. The evidence points to the latter explanation being the correct one, the hot tungsten measurements being due to tungsten and the cold measurements being due to oxidised tungsten.

Experiments with tantalum (73) indicate for the  $O_{II}$  level a movement of 3.2 volts in the same direction as that observed for tungsten (74). Curiously enough, there seems to be little shift of the  $O_{III}$  level.

F. C. CHALKLIN  
L. P. CHALKLIN

Physics Laboratory, University College,  
London, W C 1, May 6

<sup>1</sup> *J. de Phys.*, 8, Series vi, p. 484, 1927

<sup>2</sup> *Z. Phys.*, 69, p. 618, 1921

#### Overseas Forestry Officers and Home Appointments

THE issue of NATURE for April 9 included an advertisement of a vacancy for an assistant in the Department of Forestry of one of the universities. The advertisement stated that experience in a Government forest service was very desirable, but the period of only one month allowed for the submission of applications practically precluded the candidature of many officers of the overseas forest services. I think that there must be many able and experienced forest officers in those services who would welcome the opportunity of applying for a vacancy of the nature advertised, and would suggest that universities and institutions having similar vacancies to fill would be able to choose from a much wider field of applicants if longer notice were given.

J. P. MEAD

Office of the Director of Forestry,  
F M S and S S,  
Kuala Lumpur, May 12

#### Chemical Warfare and Disarmament

WE should all be grateful for the eminently sane leader on this subject in NATURE of June 4. The real objection to the use of toxic vapours is that they are too humane. Nearly all the injured soldiers return to the active list after a few months, with the result that the war is prolonged. The use of feeble weapons does not really diminish the number or the seriousness of casualties in war. Supposing that the combatants in 1914-18 had been armed only with swords and daggers, but that the means of transport and therefore the numbers had remained the same, the slaughter would have been much worse, because in every battle the losing side would have been practically annihilated in the hand-to-hand conflict.

I personally am sceptical about the fearful mortality

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predicted by Prof. Langevin and others as the result of the release of gas bombs over our large cities. Every day hundreds of tons of carbon monoxide are given off by motor cars in our streets, but no one is killed, and it is not certain even that our health is affected. The toxic vapours used in warfare are much more potent than carbon monoxide and are heavier than air, but I am not convinced that they would have a worse effect than an equal quantity of high explosive, which, however, would be sufficiently disastrous if used in really large quantities.

As regards Dr. Delisle Burns's letter, he might with advantage study that of Prof. Cockerell on "Internationalism and Science" also contained in NATURE of June 4. We are all in danger of mistaking "feeling" for "thought". The problem of international peace, commercial as well as military, is mainly one of mass psychology. Will not the psychologists give us a lead?

A. MARSHALL

3 Hillsleigh Road,  
Camden Hill, W 8, June 4

#### Light and Sexual Periodicity

I AM much interested by Mr. L. J. Llewellyn's letter under this heading,<sup>1</sup> having long wished to obtain information on the effect of absence of sunlight in arctic regions. Eventually everything is traceable to sunlight, but may not the immediate cause, during the dark period, of sexual inefficiency, be the lack of vitamins in the winter food? Have they any vegetable food? It has been reported that sterilised milk causes infertility in male rats. We are now learning that our own food, during the low-temperature, low-light period, is greatly deficient in quality—to what extent we have as yet no idea. Animal health and activity are at their lowest at this period. Our reaction to sunlight is probably dependent upon the existence within us of special materials derived from our vegetable food. The sun appears to have no particular recuperative antirachitic value in the east, where the quality of food is at its lowest, owing to soil starvation. A closer study of dietaries is needed in this connexion.

HENRY E. ARMSTRONG

55 Granville Park,  
Lewisham, S E 13

<sup>1</sup> NATURE, June 11, p. 868

#### Eland-Ox Hybrid

DR. WARREN'S<sup>1</sup> interesting cow-eland hybrid is the sixth mammalian intergeneric cross of which I can find a record. The polecat and ferret, which hybridise have been placed in different genera, but with very doubtful propriety. Apart from these, the other crosses all involve *Bos*. *Bos taurus* ♀ has given hybrids with *Poephagus grunniens*, *Bison bison*, and *Bison bonasus*, and *Bos indicus* ♀ with *Bibos frontalis* and *Bibos sondanus*. In every case the male hybrids were sterile and the females fertile. There was also a significant excess of females where the sex ratio was recorded. I have summarised the literature elsewhere.<sup>2</sup> It is to be hoped that if Dr. Warren's male hybrid calf proves sterile, as seems likely, its testes will be preserved for cytological examination, and the attempt made to breed female hybrids.

J. B. S. HALDANE

John Innes Horticultural Institution,  
Merton Park, London, S W 19, June 7

<sup>1</sup> NATURE 129, 828, June 4, 1932

<sup>2</sup> J. Genet., 12, 101, 1932



## Research Items

**Nicobarese Burial Customs**—Some observations of hitherto unrecorded ossuary customs practised on the islands of Bompoka and Teressa in the southern area of the Nicobars are recorded in *Man* for May by Mr C J Bonnington. A man of Teressa is buried with his head pointing west as he lies on his back. A soul figure in the form of a post is placed over the grave, which is covered with cloth and the general belongings of the deceased, as well as the head-dress worn by his wife on festive occasions and the skulls of the pigs killed by him, which had hung in his hut as ornaments during his lifetime. In the case of individuals without near relatives, the body is placed as soon as possible in a half-canoe. This is then hung by fibre ropes on a pole supported by two trees in the communal ossuary, which is situated in jungle by the seashore. The body is left to rot, and as the canoe breaks up, the bones fall to the ground to mingle with those of past generations. With burials the remains are disinterred after some months, and if the deceased has been a revered personage, the skull is placed in a life-sized wooden body, which is hollow and has a door in the back through which the remaining bones are introduced. This figure is kept in the hut of the nearest relative. The bones of less important people are kept in little log coffins. These receptacles are kept stacked around the walls of the hut. In one instance observed the figure has a human skull for the head. This was the mother of the present headman, who had been a witch doctor. At meal times food is placed before the wooden figures for the spirits who dwell therein. After a period of sometimes ten years, in which the pig stock of the community is considerably increased, a large feast is held and the bones of the less important people are thrown into the common ossuary. A parallel is cited from Assam.

**The Eskimo of Alaska**—The annual report of the Smithsonian Institution of Washington (*Pub* 3134) on its investigations and field work in 1931 includes an account of investigations which bear on the prehistory of the Eskimo and throw light on a number of points which have hitherto been obscure. During the summer season Dr Aleš Hrdlička was engaged in the collection of skeletal remains and objects of material culture from prehistoric sites on the Nushagak River and watershed. Anthropometric measurements of the living were also taken. One site on Uyak Bay which was investigated is, it would appear, the oldest yet discovered in the far north. It is concluded that the natives of the Nushagak River and watershed are definitely all Eskimo, belonging to the south-western type, and are identical with the Kuskokwim and the neighbouring Tundra Eskimo from whom they are largely, if not entirely, derived. It is evident that the peninsula was a sieve for movements of the people from the north southwards, and that all comers from the Bering Sea and north-western Asia would naturally come along the western coast, cross by the passes, carrying their skin boats over the few rapids and portages, and find themselves facing Kodiak Island or Cook Inlet, whence the way would be open to the north-west coast and the rest of the continent. The peopling of America, therefore, took place not through Alaska but along its western coast and through the peninsula.

**Life History of a Fresh-water Snail**—An investigation of the growth, longevity, and fecundity of the fresh-water snail, *Lymnaea columella*, a species easily reared in aquaria, a free breeder which reaches

maturity rapidly, has been carried out by Joshua L. Baily in the Biological Research Institute of Johns Hopkins University (*Biol. General*, Bd 7, 1931, p 407). The maximum duration of life in the specimens which reached maturity ranged from 130 to 139 days, and the youngest mature individual died at 72 days old. In the latter case the number of eggs laid was 64, in the former the numbers varied from 427 to 693, but 725 eggs were laid by an individual which died at 126 days. It is probably true, nevertheless, that total egg-production is directly associated with duration of life and with limiting shell size, and that duration of life is inversely associated with maximum growth rate. Growth itself, as measured by aperture length, is orderly and regular, and can be represented by a logistic curve, another addition to the number of forms in which individual growth can be thus described. The evidence, although suggestive, is less definite regarding the relation between duration of life and limiting shell size, and between the size of a clutch of eggs and limiting shell size, both of which seem to be directly associated.

**Diving Powers of the Pelagic Insect, *Halobates***—*Halobates*, like some related fresh-water Hemiptera, skims upon the surface film, but whether it can break the surface and dive below, for example to avoid storms, has been in dispute. Dr H C Delsman, contrary to the statements in the "Cambridge Natural History", wrote in 1926 (*Treubia*, vol 8, p 384), "*Halobates* cannot dive. When frightened it always takes recourse to rapid flight." Now G M Henry states that he has seen an Indian Ocean species, *H. flaviventris*, at close quarters while he was bathing, and that there can be no doubt that this species, at any rate, dives freely when disturbed, and reappears on the surface (*Spolia Zeylanica*, vol 16, p 353, March 1923). The actual dive was so quick that a *Halobates* scudding along before the observer appeared merely to vanish suddenly. Under water, however, the movements of the insect were impeded and it could be seen for a fraction of a second before it broke the surface-film on returning to the surface. It would be interesting to know by what means, since apparently they do not indulge in high diving, the insects are able to overcome the surface tension.

**Californian Fisheries**—Recent researches in fisheries are embodied in three Bulletins (Nos 28, 29, and 30) of the Division of Fish and Game of California. The first of these (28) is a most useful guide, entitled "Handbook of Common Commercial and Game Fishes of California", by Lionel A Walford. This work, primarily intended for the use of those with little or no scientific knowledge, aims at establishing official common names of those Californian fishes which are handled commercially or are of special interest to fishermen or dealers. It was enacted in 1919 in a State law that "the Fish and Game Commission shall have the power to decide what is the common usage name of any variety." Thus the names given are official. We find here clear illustrations of anatomical terms, a key to the identification of certain fishes, and descriptions and illustrations of the fishes, each occupying a page, the figures being taken from excellent photographs. The common and scientific name, relationship, distinguishing characters, distribution, fishing season, importance, fishing gear are given in every case. Besides the true fishes some commercial invertebrates are also described. An appendix at the end includes a glossary of names of the fishing gear used in California, and notes on the meaning of

scientific names. The second bulletin (29) is on the "Striped Bass of California (*Roccus lineatus*)" by Eugene C. Scofield. This fish was only brought to California in 1879 from the Atlantic, and ten years after was already a commercial success. The report describes methods of fishing, life history, and details of the commercial catches. The third bulletin (30) is by the staff of the Bureau of Commercial Fisheries on the "Commercial Fish Catch of California for the Year 1929."

**The Discovery Nebaliacea**—Before the *Discovery* Expedition collected in the South Atlantic seven specimens of *Nebaliopsis*, this genus was known from four specimens, one of which was merely named as "a new *Nebalia*" and was lost. The two original specimens were collected by the *Challenger* Expedition and another by the *Valdivia* Expedition. Of the seven *Discovery* specimens, six were crushed or fragmentary, but one was complete and undistorted. That this species lives at great depths is confirmed by the collection of one example at a depth of about  $1\frac{1}{2}$  miles. By studying the undistorted example, Prof. H. Graham Cannon (*Discovery Reports*, 3, 199-222, 1931) has been able to ascertain the normal arrangement of the limbs and to deduce the mode of feeding. After describing the limbs and their movements, he remarks that the trunk limbs, which have a very thin cuticle, depend to a great extent on the blood-pressure for their turgidity, and differ markedly from the powerful swimming pleopods, which have an abundant musculature and a thick cuticle. The deduced movements of the trunk limbs would result in a forward current in the mid-ventral line, laden with food particles, which are retained by the setæ borne by the inner margins of the trunk limbs, from which they are scraped off and passed forwards by the mandibular palps to the mouth. *Nebaliopsis* is the most specialised of the Nebaliacea, and is regarded as having evolved from a planktonic *Nebalia*. One specimen of *Nebaliella extrema* was found by the *Discovery* in the Palmer Archipelago, and the examination of its trunk limbs shows that they are arranged as in *Nebalia* and have a corresponding setal armature. Epipodites are absent, but each of the proportionally larger exopodites has taken the place of the combined exopodite plus epipodite of *Nebalia*. Interesting observations on the rostrum and the eye-stalks—here thin-scythe-like plates—suggest their function in ploughing through the mud and in guarding the anterior opening of the carapace against choking by mud as the animal pushes itself forward by the spinose third and fourth segments of the antennæ. Eight specimens of *Nebalia longicornis* were collected in South Georgia, the Falkland Islands, and near Simon's Town, South Africa.

**Plant Immunity**—A very interesting point of view has stimulated the investigations of Dr. A. C. Leeman into plant immunity ("The Problem of Active Plant Immunity", by A. C. Leeman *Zent. Bakteriologie*, Abt. II, Bd. 85, pp. 360-376, 1932). It is recognised that antibody production and related phenomena, as they are associated with the animal body, play no direct part in the immunity of a plant. But the author has shown that certain extracts and organic substances play a considerable part in stimulating the resistance of a plant to attack by a fungus disease. The substances, when added to the soil, are harmless to the parasite, but become detrimental when taken into a plant and incorporated with its protoplasm. Secretions and extracts of micro-organisms, and various enzymes, have been found to reduce the damage caused by the parasitic fungus *Helminthosporium sativum*. The interaction of micro-organisms has also been studied as a means of disease control.

**X-Ray Standards**—The preliminary report on the comparison of the X-ray standards of the United States, Great Britain, Germany, and France made by Dr. L. S. Taylor of the Bureau of Standards to the Third International Congress on Radiology in July has been issued in full (*J. Research*, January). The comparisons were made by means of a portable guarded field ionisation chamber taken to each laboratory. The agreement between the standards is much better than is required for present-day practice. The joint recommendations of the Bureau of Standards, the National Physical Laboratory, the Reichsanstalt, and the Hôpital St. Antoine as to the open-air ionisation chambers to be used in standardisation are given in full, and include the use of a focal spot less than 0.8 cm. in diameter, the shielding of the ionisation chamber from all radiation except that from the face of the target, the use of an aperture of the ionisation chamber not much smaller than 0.8 cm. diameter, with the collector electrode as near as possible to the aperture, and the measurement of the current by a null method if possible.

**Photoelectric Cells**—An article by C. J. Smithells, of the General Electric Co. (*Chemistry and Industry*, May 20), gives an account of the applications of photoelectric cells in chemical engineering, and incidentally of the modern types of such cells. There are four main types, namely, the selenium cell (with which may be classed the more modern thalofide cell, in which thallium oxysulphide is the light-sensitive material), the alkali metal cell, the copper oxide rectifier, and the electrolytic cell. The selenium and thalofide cells, which have the greatest sensitivity but are not suited for accurate measurement, depend on the decrease in ohmic resistance of the material on exposure to light. The alkali metal cell has a cathode plate covered with alkali metal, from which electrons are emitted on exposure to light, the current being proportional to the amount of light. The copper oxide rectifier consists of a layer of cuprous oxide on copper, and if a gauze is placed on the oxide layer, a current will flow between the gauze and the copper when light falls on the oxide through the gauze. No external e.m.f. need be applied. A similar effect is obtained with selenium on lead. This is the basis of the German Sperrschicht cell. The electrolytic cells make use of the Becquerel effect, the development of an e.m.f. by substances such as cuprous oxide in a solution of potassium sulphate on illumination, a current flowing between this electrode and another one, for example, platinum, in the solution. The advantages and disadvantages of all these types of cell are discussed, and their uses explained, in the article. The very small currents from the cells are amplified by means of thermionic valves, and with this type of apparatus the alkali metal photoelectric cell is most suitable. An even better arrangement than a thermionic valve and relay is a gas-filled relay, sometimes called a thyatron.

**Internal Perturbations in Atoms**—A paper has been published by A. G. Shenstone and H. N. Russell in the first February number of the *Physical Review*, on perturbed series in line spectra, which may lead to a rapid development of the analysis of some spectra which have hitherto proved intractable. It is based upon the idea of resonance in quantum mechanics. If an atom has two states of similar quantum properties, and comparable energy, these may affect each other in such a way that their separate identity partly fails, and they give rise to two states, each of which has an energy different from that which it would normally possess. A quantitative expression for this, not unlike an anomalous dispersion formula, was given two

years ago by R. M. Langer, and it is this which has now been applied to a large number of actual spectra. The perturbations are remarkably common, occurring in such well-known spectra as those of neutral calcium and neutral copper, and can now be detected readily by a graphical method which has been elaborated. In addition, where both of the interacting states have been wrongly included in a single series, this can be recognised; strictly speaking, it is not that one state is associated with one series and the second with another, but that each state belongs to both, but it is often convenient to make the admittedly rather arbitrary distinction. In the present paper, the spectra Ca I, Ba I, Hg I, Cu I, and Al II are discussed in some detail, and a number of corrections and additions are made to the older analyses of these.

**Sal Alembroth.**—In the *Festschrift für Georg Jacob zum siebzigsten Geburtstag*, Prof. J. Ruska has an article (pp. 234-240) on *Sal Alembroth*. This term is at present applied to a compound  $\text{HgCl}_2 \cdot 2\text{NH}_4\text{Cl} \cdot \text{H}_2\text{O}$  (probably mixed with  $\text{NH}_4\text{Cl}$ ), and has been used in the same sense since the end of the seventeenth century, if not earlier. In medieval times, however, the name appears to have been given to various other substances, for example, one made "ex septem herbarum succis", and there is little doubt that, like many other alchemical terms, it is a transcription of some Arabic name. Prof. Ruska considers the various possibilities that suggest themselves, and rejects the tempting etymology from the Greek *ἀμβροτος*, since this word is not found in Greek alchemy. The derivation from *al-mabrûk*, "the blessed", which on general grounds appears most likely, is rendered improbable by the fact that no particular compound in Arabic alchemy appears to have been known as *milh mabrûk*, *sal benedictus*. A last possibility is that *alembroth* is a mistranscription of *alṭabarzad*, a Persian word meaning scissile: such Persian terms, frequent in

Muslim alchemical books, would often be unintelligible to a western translator, and would consequently be particularly liable to corruption.

**Safety Glass.**—Mr. J. Wilson, of the Triplex Glass Co., has given an interesting account (*J. Soc. Glass Tech.*, March 1932) of the history, manufacture, and testing of safety glass. The first successful safety glass, Triplex glass, was invented by Edouard Benedictus, although the underlying idea had been patented in 1905 by Wood. Practically all forms of laminated safety glass at present in commercial use consist of two sheets of glass with an interposed sheet of either celluloid or cellulose acetate. In the process used in making safety glass, the clean dry glass is first coated with an extremely thin film of gelatin and re-dried, although some makers omit the gelatin treatment. The glasses and celluloid or cellulose acetate sheet are then assembled, either by vacuum treatment in bags, the lamination being completed by hot water under pressure on the outside of the bag, or else by the use of an inert assembly liquid sprayed over the plates, followed by rolling and pressing, the latter being accomplished in autoclaves in the modern process. The edges are then usually sealed by removing a short strip of the celluloid round the edge and filling with hot bitumen. The glass is subjected to tests: for brittleness and adhesion by dropping a weight on a test piece, for blisters and bubbles by boiling with water, for efficiency of sealing by exposure to moist air, and for discoloration by exposure to ultra-violet light. No commercial safety glass is absolutely fast to light, but the best acetate glasses are better in this respect than the best nitrate glasses. Polymerised resins, such as polyacrylic acid esters, seem to offer advantages over celluloid or cellulose acetate, as they are fast to light and do not require sealing at the edges, although at present there are manufacturing difficulties in their use.

### Astronomical Topics

**The Lunar Bright Rays.**—Messrs. Buell and Stewart have carried out an interesting experiment to test a theory of the nature of the systems of bright rays that surround many lunar craters (*Pop. Ast.*, May). It is well known that the rays are best seen at full moon; this applies to all parts of the disc, both those where the sun is high and where it is low. The suggestion is made that they are conspicuous when the angle between the earth and sun as seen from the moon is small, for the reason that at such a time shadows on the moon are practically absent. The authors think that the rays are due to some whitish powder filling up the interstices between larger, darker lumps of matter. At full moon we receive the full light from the powder, but at other times a large proportion of the powder is in the shadow of the lumps.

An artificial surface was prepared by crushing basalt into large granules, and pouring finely powdered basalt into the interstices; the powder appears much whiter than the granules. The surface was photographed at different angles of light-incidence, and it was found that a close correspondence existed between the results and the phenomena of the lunar rays. The authors' explanation of the rays is that large lumps of basalt (or some similar substance) were expelled from the craters, either by volcanic explosion or meteoric impact, and that the shock of striking the ground caused portions of these lumps to be pulverised, the powder filling the interstices between the lumps. The theory seems well worthy of consideration as a possible ex-

planation of the perplexing phenomena presented by the rays.

**Spectrum of XX Ophiuchi.**—The spectrum of this 'iron star' is of very unusual character and shows, in addition, remarkable variations. It is described in detail by P. W. Merrill (*Astrophys. J.*, 75, 133), who studied it during the years 1921-1931 with the Mount Wilson 100-inch reflector. The star is classed at Harvard as *Bep*, but at the beginning of the above period it was marked by strong, sharp emission lines of H and Fe II, to which were added in 1925 numerous wide displaced absorption lines. The lines of Ti II were prominent amongst the latter, and all showed variations of intensity, width, and displacement. The mean displacement of the bright H lines differed by 30 km./sec. from those of other lines. Another interesting feature is that although the star is a variable (of the *R Coronae* type), many considerable changes in spectrum occurred during a period of constant brightness, whereas a change of one magnitude in the brightness was accompanied by no appreciable change of spectrum. Some analogies to the spectra of novæ suggest a tentative explanation based on a modification of Halm's hypothesis of an expanding shell surrounding the star. The author suggests that the narrow bright lines and wide absorption lines (exactly the reverse of the conditions found in novæ) may be explained by assuming a thin shell close to the photosphere, in which a large area would give rise to the absorption spectrum and only a fraction at each limb would cause the emission lines.



### Presidents of the Royal Society and their Portraits

A PORTRAIT of Lord Rutherford, who was president of the Royal Society for the five-year term 1925-30, was formally handed over on June 9, on behalf of subscribers, to the keeping of the Society for inclusion in its portrait collection of those fellows who have occupied the presidential chair. The present example is by that facile and distinguished artist, Mr. Oswald Birley. As is generally known, Lord Rutherford was born at Nelson, New Zealand; Mr. Birley was born at Auckland, New Zealand, while both are alumni of Trinity College, Cambridge.

There is a number of such portraits of past presidents in the possession and care of the Royal Society. Unfortunately, the list is not a complete one. Regrettable gaps occur both early and late in the Society's history, but during the last half-century there has been a movement in favour of obtaining portraits of all presidents.

In the olden days a spacious canvas depicted the face, attitude, and figure of the subject through the whole-length or three-quarter mode, a representation which, to be venturesome and paraphrase Carlyle, was what a "faithful human creature" saw of a face and figure "with *his* eyes, and which I can never see with *mine*". Modern practice prefers, for various and doubtless satisfactory reasons, a smaller canvas. This involves, however, some monotony of presentation, taken together.

In those olden days alluded to, many of the portraits had divers places of abode; some were at Gresham College, in the City, thence to Crane Court, thence to Somerset House, migrating westward later on. Moreover, in those times personal gift by the president was generally observed. Lord Brouncker, the first president, who was in office for fifteen years, worthily began in this way. It may be hoped that at some future date a descriptive catalogue of all the portraits will be issued, supplementary to the present lists of portraits, with their painters and donors.

We print below the names of past presidents of the Society, with notes on some of them which are of interest in the present connexion, and with the name of the artist and donor in brackets, where portraits are in the possession of the Royal Society.

Viscount Brouncker (1662-77). There is a portrait of him in the National Gallery. It was Brouncker who signed a licence for the issue of Malpighi's "History of the Silke Worme" (1669). (Sir Peter Lely—president.)

Sir Joseph Williamson (1677-1680). Queen's College, Oxford, has a three-quarters length portrait; Williamson was educated there and was a considerable benefactor of the College. (Sir Godfrey Kneller—president.)

Sir Christopher Wren (1680-82). (Sir Godfrey Kneller—Stephen Wren.)

Sir John Hoskyns (1682-83). No portrait. Long on the council, with Wilkins, Evelyn, and Moray, amongst others. There is a three-quarters portrait of him at Corpus Christi College, Cambridge, in the ownership of a descendant.

Sir Cyril Wyche (1683-84). No portrait.

Samuel Pepys (1684-86). The "Principia" was ordered to be printed on Pepys' *imprimatur*. (Sir Godfrey Kneller—president.)

Earl of Carbery (1686-89). No portrait.

Earl of Pembroke (1689-90). No portrait.

Sir Robert Southwell (1690-95). (Sir Godfrey Kneller—president.)

Charles Montagu (afterwards Earl of Halifax) (1695-1698). No portrait.

Lord Chancellor Somers (1698-1703); painted in judicial robes of office. (Sir Godfrey Kneller—Sir Joseph Jekyll.)

Sir Isaac Newton (1703-27). The Society possesses three portraits. The chief is that by J. Vanderbank, painted in 1726, which hangs in the meeting room over the presidential chair, and was presented by Mr. C. B. Vignoles in 1841. Like the Vanderbank



LORD RUTHERFORD OF NELSON. From the portrait by Mr. Oswald Birley.

in the National Gallery, the subject is depicted seated. Newton himself presented a portrait in 1717, by Charles Jervas, sometime a pupil of Kneller [For the third portrait see below, Martin Folkes]

Sir Hans Sloane (1727-41) (Sir Godfrey Kneller—Sir Hans Sloane, 1716, after the close of his secretaryship)

Martin Folkes (1741-52) In addition to his own portrait, Folkes gave the Society a choice portrait of Francis Bacon, also one of Newton, signed by Vanderbank. Folkes was also finely delineated by Thomas Hudson, almost whole-length, seated in the presidential chair, the mace in the picture. This portrait is not at the Royal Society (William Hogarth—president)

Earl of Macclesfield (1752-64) (Thomas Hudson—president)

Earl of Morton (1764 to Oct 12, 1768) No portrait  
Sir James Burrow (Oct 27, 1768, to Nov 30, 1768, and July 2, 1772-Nov 30, 1772) This fine portrait shows him three-quarters length, in velvet surtout, with neckcloth, seated near a table, on which the left arm is resting (J. B. Van Loo—president)

James West (1768-July 2, 1772) No portrait.

Sir John Pringle (1772-78), the "Father of Military Hygiene" (Sir Joshua Reynolds—president)

Sir Joseph Banks (1778-June 19, 1820) Almost whole-length, seated in the presidential chair, in full panoply of the insignia of the Order of the Bath, with the mace and a silver-gilt inkstand, showing upright quills. Probably the portrait of him in the British Museum, by Sir Thomas Lawrence, would receive preference, where the accessories are not so oppressively obvious in the scheme (Thomas Phillips—executors of Don José de Mendoza Rios)

W. H. Wollaston (June 29, 1820-Nov 30, 1820), one of the seventeen children of a clergyman (J. Jackson—president's family)

Sir Humphry Davy (1820-27), almost whole-length, standing, facing spectator (Sir Thomas Lawrence—Lady Davy, in 1829)

Davies Gilbert (1827-30). (Thomas Phillips—president)

H. R. H. the Duke of Sussex (1830-38) During his tenure of office he constantly presided at meetings of the Council and Society (Thomas Phillips—president)

Marquess of Northampton (1838-48) (Thomas Phillips—president)

Earl of Rosse (1848-54) (J. Catterson Smith—president, in 1860)

Lord Wrottesley (1854-58) No portrait

Sir Benjamin C. Brodie (1858-61), like Wollaston, Brodie was one of the seventeen children of a clergyman (After G. F. Watts—Sir B. Brodie, in 1873)

General Sir E. Sabine (1861-71) (Stephen Pearce—Mrs Sabine)

Sir George Airy (1871-73) No portrait

Sir Joseph Hooker (1873-78) (Hon. John Collier—subscribers, 1881)

William Spottiswoode (1878-June 27, 1883) (Hon. John Collier—subscribers, 1885)

Thomas H. Huxley (July 5, 1883-85) No portrait.

Sir Gabriel Stokes (1885-90) (Hubert von Herkomer—subscribers, 1891)

Lord Kelvin (1890-95), almost whole-figure, and seated in a characteristic attitude, familiar to contemporaries (Sir W. Q. Orchardson—subscribers, 1899)

Lord Lister (1895-1900) Almost whole-figure. Mr. Oulless painted the masterly portrait of Darwin, etched by Paul Rajon (Mr. W. W. Oulless (copy)—purchased)

Sir William Huggins (1900-5), depicted seated in presidential chair (Hon. John Collier—subscribers, 1905)

Lord Rayleigh (1905-8) Almost whole-figure, seated. As in the portrait of Lord Kelvin, the attitude is characteristic, and familiar to his contemporaries (Sir George Reid—subscribers, 1903)

Sir Archibald Geikie (1908-13) (Mr. Reginald Eve—subscribers, 1914)

Sir William Crookes (1913-15) (Mr. E. A. Walton—subscribers)

Sir J. J. Thomson (1915-20) (Mr. G. Fiddes Watt—subscribers, 1922)

Sir Charles Sherrington (1920-25) Mr. Reginald Eve—subscribers, 1928)

Lord Rutherford of Nelson (1925-30) Three-quarters length, in academical robes, standing, right hand on hip, left hand resting on books below, near radium emanation apparatus (Mr. Oswald Birley—subscribers)

### The Film in National Life

THE report of the inquiry conducted by the Commission on Educational and Cultural Films has just been issued under this title. It makes a substantial book of 204 pages, and is published at the very low price of 1s net (London: George Allen and Unwin, Ltd.). The Commission was set up in 1929 as a result of a conference representing some hundred educational and scientific organisations. Its field of study included methods of improving films and extending their use for educational and cultural purposes, raising the standard of public appreciation of films, and establishing a permanent central organisation for such purposes. The Commission has since received influential support, and four interim reports have been issued. Its final recommendation is "That a National Film Institute be set up in Great Britain, financed in part by public funds and incorporated under Royal Charter." It is pointed out that the chief countries of the world all possess such organisations, which vary in scope, but in no cases are concerned with censorship. An important place is assigned to the film in national life in Austria, Germany, Italy, Japan, Russia, and the United States.

The magnitude of the film industry needs no com-

ment. It is estimated that there are in the world more than 60,000 cinema theatres, about half of which are wired for sound. About 85,000 people are employed by the State in the cinema industry in the U.S.S.R. alone, where the film doubtless serves as an exceedingly powerful instrument for influencing public opinion.

Films have already proved their value in medicine, in nature study and botany, in technical education, and in demonstrating industrial processes. Their application for conveying instruction on agricultural matters is specially noteworthy. Thus in the United States, films of this nature have been shown to more than twenty million farmers, and it is estimated that in Italy five to six million people saw the film entitled "The Wheat Campaign", prepared by the National Film Institute, Luce. The inestimable value of the film for recording history is evident. The official War films illustrated possibilities in this direction. Films have likewise been used in connexion with mountaineering adventures, for the study of racial subjects, and in the photomicrographic form for revealing physiological processes and for studying the growth of plant life.



At present, however, such records are made in a somewhat haphazard manner. There is no deliberate effort to collect representative records of the present age, and as yet no permanent centre where such records could be stored. The 'film library', in fact, is in its infancy. Problems of storage and the whole technique of such a library have received little study. Research has revealed that in the case of negative films taken twenty years ago, the celluloid base is gradually disintegrating. It appears that an acetate base is more stable, and positives on such a base are being made as a stand-by. Evidently this question of the permanence of films of national value is one of great importance, on which further research is needed.

A considerable portion of the report is devoted to the use of films as an educational medium in schools. The film, as a means of instruction, has certain definite advantages over oral methods. It acts as a stimulant, sharpens the critical faculty, and widens the mental horizon, and may be applied to develop dissatisfaction with the inferior and the commonplace. The quality of recollection is more vivid and the impression more lasting than when facts have been presented orally.

It is suggested that films can be applied in three chief ways: (1) in the classroom for teaching, (2) for occasional demonstrations in the school hall on subjects of general interest, and (3) in public cinema theatres, where films making a special appeal to children should be exhibited. Even in such a poor country as Austria, the use of central cinema halls, to which neighbouring schools can send contingents of children, has been developed. Another device, familiar in Italy and Russia, with which experiments have been made in England, is the travelling van.

The great difficulty is that there is at present no machinery for providing contact between university and school staffs and the producer. Many teachers are anxious to obtain educational films, and there are firms willing to make a specialty of producing them, but firms are unwilling to enter upon production without a certainty of a market, and educational authorities are reluctant, even when funds are available, to expend money in this direction without full knowledge that the film will be really suitable for their purpose.

The report contains some data on the cost of production. A feature film, as shown publicly, may cost at least £2000 a week to make and at least £3 a foot in its final form. An educational sound film might cost between 10s and 30s a foot, so that a reel of 1000 ft would cost £500-£1500. The production of such a film demands means of linking the expert skill of the producer and technician with the professional knowledge of the specialist and the teacher.

As regards size of film, it is believed that the 9 mm type is only suitable for the private cinema and for research. It is expedient to aim at the use of the 16 mm standard for classrooms (giving a picture 5 ft x 6 ft or 3 ft x 4 ft), and the full size (35 mm) for halls when films of general interest are shown. In an appendix to the report there is a useful list of projectors, accompanied by particulars of price, pressure, wattage and price of lamps, and other data. Of the types recommended for general educational use, the 16 mm projector costs from £15 to £80 and the 35 mm from £60 to £150. The latter figure would probably have to be multiplied by four if sound production apparatus were included.

The proposed National Film Institute should serve as a positive agency to encourage valuable and good films rather than discourage bad ones. Government recognition appears essential, but the Institute might be either a Government department or institute or an incorporated institute, or a combination of both. Its functions would include acting as a national clearing-house for information and research, assisting in the preparation of film records and serving as a national repository of films of permanent value, the stimulation of public opinion to demand good films, giving advice to teachers and instructors who need films in connexion with their work, acting as a means of liaison with trade, producers, experts, cultural interests, and educators, and encouraging research. Although the present time, when demands for economy are so imperative, is scarcely opportune for advocating the formation of a National Film Institute, it is felt that ultimately the nation would receive a more than adequate return for the expenditure involved.

### Jeremy Bentham, Philosopher and Social Engineer

THE centenary of the death of Jeremy Bentham was commemorated on June 6, at University College, London, when a public lecture was delivered by Mr C. K. Ogden on Bentham's work.

Mr. Ogden dwelt chiefly on those aspects of Bentham's work which, in his opinion, will claim the attention of future generations. His influence on the past and his message for the present were based upon his profound analysis of the symbolic factor in every branch of human activity. Bentham's exposure of word magic was motivated partly by reflections on the fear of ghosts which dominated his childhood, and partly by a dislike of legal fictions generated by Blackstone's lectures at Oxford. It was not until after his sixtieth year, however, that he embarked on the systematic development of his theory of fictions, which anticipated Vaihinger's "*Philosophie des Als Ob*", as well as the modern formalistic account of mathematics. It enabled him to provide a 'technological' account of language, such as modern science demands.

Bentham's most original contribution consisted in the elaboration of a technique of 'archetypation' by means of which the fictions of physics and psychology could be translated into the basic pointing symbols, which are the archetypes of all metaphor, all fictions, and all abbreviations. He himself ex-

plained his social and legal theories, which had so profound an effect upon the history of the nineteenth century, as applications of the principles of experimental science in the field of economics and government. From this same point of view he championed the cause of the inventor and of technical education. His younger brother, Sir Samuel Bentham, the famous marine engineer, and his nephew, George Bentham, one of the founders of systematic botany, were as much his disciples as Ricardo and Jevons in economics or Southwood Smith and Chadwick in matters of public health.

According to Bentham, all language, all symbolic forms, must be interpreted in an *operational* context. Some words point at things as the hands of a clock point at the hours, others, such as 'right', 'faculty', 'motion', 'redness', or 'of', are like single parts or accessories of a clock. They may help us to do the pointing, but any such part taken in isolation is no more than an intriguing piece of metal about which any number of conflicting theories may be held. Put it back in its place, where it helps to perform some operation, and it can be treated functionally. Above all, we can see what substitutes are possible, either for any particular part or for any portion which operates as a unit.



By neglecting the implications of the technological analysis, philosophy has become, almost entirely, the unjustifiable exploitation of the metaphorical, the fictional, and the elliptical. Bentham's method of archetypation, as shown by Prof S M Buchanan's recent study, "Symbolic Distance", does all that the logico-analytical theory of 'incomplete symbols' can do, without resort to logical or mathematical jargon at any point.

Bentham's interest in re-formulation found expression in his powerful advocacy of codification, a word which, like 'international', 'maximise', 'minimise', etc., he himself introduced. But the most significant application of Benthamic principles is in connexion with the problem of a universal (auxiliary) language.

Mr Ogden explained how, by developing certain suggestions put forward by Bentham, he had succeeded in formulating a system whereby 850 English words could be used to take the place of a normal vocabulary of 20,000, for all the purposes of everyday life, general talk, news, trade, and science. To the eye and ear this system, known as 'Basic English', is scarcely distinguishable from standard English, indeed, for some five minutes, Mr Ogden made use only of 'Basic English', a fact of which the audience was unaware until they were informed of it.

Mr Ogden concluded with a plea for a more careful study of Bentham's neglected manuscripts and of the symbolic material printed in his posthumous works. It was Talleyrand who said of Bentham, "Though all the world has stolen from him, he is still rich", and to the inventor and experimenter of the future he may well appear as the founder of a new science, which might be appropriately christened 'Orthology'—the systematic analysis and ordering of symbols at the level of ordinary communication.

## Calendar of Geographical Exploration

### June 19, 1908—Northern Arabia

Alois Musil arrived at Damascus, whence he made surveying expeditions and reached Resafe, 12 miles from the Euphrates, the most northerly point which he visited. Resafe is of great interest because of its ruined churches and palaces and its Greek, Aramaic, and Arabic inscriptions. By several journeys Musil made a plane table survey of the whole region. He made other journeys in face of great difficulties, his work resulted in the preparation of a map of northern Arabia, including the district from 37° to 44° E long and from 36° to 27° N lat. Important additions to the map of Arabia Petraea were made, and much new knowledge of the ethnography, linguistics, and natural history of northern Arabia was gained.

### June 21, 1764—The Falkland Islands

Commodore John Byron, who had taken part twenty-five years before in Anson's circumnavigation, sailed from the Downs to look for islands or lands between the Cape of Good Hope and the Strait of Magellan. His voyage was the first of a series which widened the knowledge of the Pacific. Byron reached the Falkland Islands and took possession of them for King George III, though a French colony had been settled there in the previous year by Bougainville. The islands were discovered by John Davis in 1592 and known as John Davis's South Land. In 1690, John Strong discovered the strait between the two main islands and named it Falkland Sound, the name Falkland being transferred to the whole group by Byron. Byron then discovered the Islands of Disappointment to the north of the Low Archipelago, King George's

Island, and Nukunau or Byron Island in the Gilbert group, ultimately reaching England in 1766.

### June 21, 1882—Alexandra Land

B Leigh Smith, who had previously made three journeys to Spitsbergen, set off with his party to try to reach some vessels off Novaya Zemlya. Leigh Smith had set out in the *Eira*, a steam yacht, in 1880, had sailed along the south side of Franz Josef Land to the west, and had discovered 110 miles of coastline of a new island named Alexandra Land. In 1881, Leigh Smith sailed again for Franz Josef Land, but the vessel was caught in the ice and sank. The party built a hut and wintered on the shore, setting off in boats on the date given above. They were met by the *Willem Barents*, a Dutch vessel which made annual polar explorations for many years.

### June 22, 1878—Voyage of the *Vega*

A E Nordenskiöld left Karlskrona in the *Vega* for his famous voyage round Asia and Europe. The *Vega* sailed through the polar seas off northern Siberia and passed through Bering Strait, "thus after the lapse of 336 years [since Willoughby's voyage] and when most men experienced in navigation had declared the undertaking impossible, was the north-east passage achieved." Nordenskiöld had previously reached the mouth of the Yenisei in 1875 in a walrus-hunting sloop, the *Proeven*, and again in a steamer, the *Ymer*, in 1876. His preparations for the voyage of 1878 were very thorough and included a study of the records of previous travellers in various regions of northern Siberia, chiefly from the point of view of the condition of the ice and the direction of the wind at various dates in different years. The *Lena*, which had accompanied the *Vega*, parted from it at the delta of the Lena River about Aug. 27-28 and steamed to Yakutsk, the first vessel from the northern ocean to reach the heart of Siberia. The *Vega* proceeded eastwards to 67° 4' N and 173° 23' W, when she was shut in by ice on Sept. 29, and the party had to spend the winter there. The diet had been carefully thought out and the health of the party remained good, no case of scurvy occurring, nor was there any case of serious frostbite. Meteorological observations were taken every four hours up to Nov. 1, after that date every hour up to April 1, and then again every four hours. Friendly relations were established with the Chukchi, and during the 10 months' winter much useful ethnographical and linguistic information was collected. The *Vega* sailed on July 18 from its winter home and sighted East Cape (now Cape Dezhnev) on July 20. Data about the Eskimo at Port Clarence were collected, a survey of Bering Strait was made, Bering Island was visited and described, and attempts were made to record the date of extinction of Steller's sea cow (*Rhytina Stelleri*, Cuvier), which was abundant on the island when Bering and Steller were wrecked there. The *Vega* then proceeded to Japan, and afterwards returned to Europe via Ceylon, Aden, and the Suez Canal. The voyage was remarkable for the care with which it was organised, and for the masses of scientific data collected by the distinguished group who accompanied Nordenskiöld, as well as for its pioneer geographical character.

### June 24, 1339—An Early Traveller to China and the East

John Marignolli, a Florentine missionary, left Kaffa, whence he went overland to Kulja and Peking. He stayed four years in China, returning by sea. He describes southern China, gives glowing accounts of the beauties of Ceylon, and mentions Ormuz as a great market town. His descriptions of his overland journey

from the Gulf of Persia to the Mediterranean are full of interesting detail. His narrative is a significant commentary on the ideas of the geography of the world current at that time. From his time onwards no traveller from western Europe passed along the land route to China for two hundred and fifty years.

#### June 24, 1914—The Vilkitski Islands

The Russian explorer, B. A. Vilkitski, started on a voyage in the arctic to survey some previously discovered islands north-west of Cape Chelyushkin. Between 1912 and 1915, Vilkitski accurately charted much of the Siberian arctic coast, made valuable oceanographical observations, discovered Nicholas Land (Northern Land) and two small islands north-west of Cape Chelyushkin, partial surveys of which were carried out in 1914. Bennett Island was also explored, and Jokhov and Vilkitski Islands to the south of it were discovered. The voyage disposed of some erroneous theories about the coast.

### Societies and Academies

#### LONDON

Royal Society, June 9—William A. Bone. The combustion of hydrocarbons (with experiments) (Bakerian lecture). The principal researches and theories concerning the chemical mechanism of hydrocarbon combustion, from the time of John Dalton until now, are reviewed and discussed in three sections, namely (1) nineteenth century discoveries, showing how the successive theories of preferential combustion, whether of hydrogen or carbon, failed, (2) development of the 'hydroxylation' theory (1900–15), together with the relevant experimental evidence from both slow and explosive combustion supporting it, and (3) recent developments—'hydroxylation' v 'peroxidation', in which the two theories are discussed in the light of both old and new experimental evidence.

#### EDINBURGH

Royal Society, May 2—L. Hogben, R. L. Worrall, and I. Zieve. The genetic basis of alcaptonuria. Altogether 151 cases of alcaptonuria recorded in medical literature have been examined. The familiar incidence of the disease satisfies the quantitative requirements of the hypothesis that it is determined by a single autosomal recessive gene substitution. The incidence of consanguineous parentage is in agreement with this conclusion. There is an isolated pedigree in which the disease behaves as a dominant trait.—J. A. Fraser Roberts. The significance of familial incidence in relation to human disease. Studies on familial incidence in relation to human disease are rendered difficult because a random sample of the population can rarely be studied. On the other hand, it is relatively simple to investigate the immediate family history of affected persons. The same difficulty arises in the case of recessive Mendelian inheritance. Owing to the small size of the human family, heterozygotes will frequently have exclusively normal children and such families will not be included in the record. Statistical methods have been worked out for eliminating this difficulty. Precisely similar methods can be applied to the study of human disease in general, whether genetic or not. The only assumption involved is that the affected persons studied are a reasonable sample of such persons. The true familial incidence can be calculated for various groupings of the material and the result discussed in relation to the pathology of the condition and other relevant data.—Hilary B. Moore. The faecal pellets of the

Anomura. A new type of faecal pellet is described, in which there is a system of longitudinal canals in the rod-shaped pellet. These cavities are produced by the solidification of semi-liquid food material round a series of bristle-like processes in the stomach, which are then withdrawn as the pellet proceeds down the gut. The canals in the pellet are arranged in a regular pattern peculiar to the species in question. This type of pellet appears to be peculiar to the Anomura, and appears both in the Galatheidea and the Thallassinidea, but not, apparently, in the Paguridea. In all, the pellets of eighteen species, from twelve different genera, are described. The structure of the pellets suggests that the stomach processes have an absorptive function, and serve greatly to increase the surface area of the gut in these mud and detritus-eating forms.—Alex. R. Horne. Graphical analysis of internal combustion engine indicator diagrams. The indicator diagram which is obtained from the engine records variations of pressure and volume only. The temperature changes, and consequently the fluctuations of internal energy, must be inferred from the values of pressure and volume, for neither of these quantities can be determined from direct experiment. The graphical methods described, when applied to the indicator diagram, make possible the construction of curves of temperature, internal energy, and work done throughout the complete cycle, while the intercepts of the ordinates between the curves of work and internal energy give the interchanges of heat between the working agent and its container. A graphical method of finding the instantaneous value of  $n$  in the law  $pV^n = \text{constant}$  is also given. By its use the rate of heat reception or rejection on the part of the working agent with respect to the rate of change of volume can be simply deduced for any point, or series of points, in the cycle.—W. G. Guthrie. Pressure effects in the secondary spectrum of hydrogen. An experimental investigation on the secondary spectrum of hydrogen as affected by the pressure of the luminous gas. The spectrum obtained with pressures of 40–50 cm is compared with that of the 'vacuum' tube, photographed under similar conditions. Tables of intensities are given for several hundred lines in the visible region.—H. Zwarenstein and I. Schrire. The adrenal gland of *Xenopus laevis*. This gland is essentially similar in distribution and structure to the adrenal of Urodeles. In addition, adrenal tissue occurs in the walls of the renal veins, inferior vena cava, aorta, and renal arteries, a condition similar to that found in some cyclostomes and fishes.—L. M. Milne-Thomson. The zeta function of Jacobi. The elliptic integral of the second kind and the complete elliptic integral of the third kind can be evaluated by means of Jacobi's zeta function. The present paper gives seven-decimal tables of  $Z(u/m)$ ,  $m = K^2$ , with first and second differences at interval 0.01 for  $u$  and 0.1 for  $m$ .—A. Blackwell. The geodesics in Einstein's unified field theory. Using Einstein's 1930 equations for a unified field theory, the geodesics are worked out. In the special case of gravitation alone, these give the motion of perihelion of a planet as  $\frac{1}{2}m^2/h^2$  and the deflexion of a light ray on grazing the sun as  $2m/a$ , whereas, in 1916, Einstein had  $\frac{3m^2}{h^2}$  and  $\frac{4m}{a}$  as the amounts required to account for the observed facts. The estimated shift of the spectrum lines is found to be the same as that given by the 1916 theory.

#### PARIS

Academy of Sciences, May 2—A. Lacroix. Recent falls of meteorites in western Africa.—L. Cayeux. The existence of numerous quartz grains, of atmospheric origin, in the Ordovician in the neighbourhood of

Leningrad The micrographic study of the sands and glauconitic limestones from the neighbourhood of Leningrad shows that, so far back as the Silurian period, the Baltic region was the seat of atmospheric movements strong enough to transport and round off sand grains This confirms the earlier work of Nathorst, who found similar evidence in West Gothland—Charles Nicolle and L Balozet Swine fever is transmissible to man in an invisible form Man is susceptible to this virus but shows no visible symptom Five days after inoculation the human blood injected into pigs gives swine fever—Ch Porcher and Mlle J Brigando The condition of the lime and phosphoric acid in cow's milk A discussion of previous work on the same subject by Piettre, with special reference to the effects of the addition of sodium citrate—Maurice Fréchet The convergence of probabilities *en chaîne*—G Cerf The integration of partial differential equations—Florin Vasilescu The normal derivatives of harmonic functions in the problem of Dirichlet—Pierre Humbert A generalisation of potential—Jacques Devisme Some partial differential equations—G Valiron The directions of Borel of certain integral functions of infinite order—Constantin Woronetz Rolling without slipping of a solid body on a deformable surface—Davin The elastic and plastic state of an indefinite two-dimensional body pierced with a circular hole—J Perès and L Malavard Drawing the lines of current in the Oseen flow round a circle—A Buhl Multipoint movements corresponding to the Jacobi equation written for the case of a single point—Ph Le Corbeiller Maintaining in oscillation the most general passive network—Maurice Curie Phosphorescent sulphides The intervention of collisions of the second kind—D Skobelzyn The degree of homogeneity of the filtered  $\gamma$ -rays of thorium-C'' and the verification of the formula of Klen-Nishina A discussion of the possibility of obtaining a monochromatic radiation by filtration through lead—Mlle Ellen Gleditsch and Ernst Foyn The determination of actinium in uranium minerals Previous work on this has given somewhat discordant results, the difficulties being of a chemical order The author gives full details of his method of separating and purifying the actinium and also protactinium, and gives results for bröggerite and Cornish pitchblende—L Andrieux and D Barbeti The alkaline borides The alkaline borides have not been isolated, but from mixtures with the alkaline earth borides it is shown that their probable formulæ are  $\text{NaB}_6$ ,  $\text{KB}_6$ , and  $\text{LiB}_6$ —Étienne Canals, Marcel Godchot, and Mlle Germaine Cauquil The Raman spectra of some cyclic hydrocarbons The Raman lines for ten hydrocarbons, ranging from cyclopropane to methylcyclooctane are given—Lemarchands and Sirof The determination of barium as chromate Measurements of the solubility of barium chromate in water and in solutions of potassium chloride—P Brauman and S Takvorian A method of preparation of the anhydrous chlorides of the metals of the cerium earths The dry benzoate of the metal is treated with ether and saturated with dry hydrogen chloride The benzoic acid is removed by ether and the anhydrous chloride remains—G Austerweil Some reactions between zeolites and slightly soluble salts—Albert Saint-Maxen The action of magnesium hydroxide on the oxidation of hydroquinone—Andre Kling and Rene Schmutz The action of dilute acids on phenyliminoquinonediazide—R Cornubert and M De Demo Contribution to the study of the dibenzylidene-cyclopentanones—Jean Lacoste The state of the pre-Riffian and Riffian tectonic problem the possibilities of co-ordination—E Chaput Geological observations in Asia Minor The Fusulinidæ formations—Auguste Chevalier The quaternary sea of Timbuctoo—Henry Hubert The

movements of the atmospheric air above Indo-China—G A. Nadson and C A Stern The action at a distance of metals on bacteria and yeasts Lead, copper, and aluminium, not in contact with the cultures, retard the development of bacteria and yeasts, the effect being greater as the atomic weight of the metal is higher—A de Puymaly Observations and remarks on lichens—A Julien and G Morin Cardiac automatism and metabolites in molluscs (*Murex trunculus*)—C Hervieux Jolles' reaction (indican) applied to milk Reply to criticisms by Porcher and Tapernoux—Louis Fage The pelagic phase of coastal benthic Amphipods—Ph Lasseur, P Vernier, A Dupax, and J Marchal Observations on the life of *B caryocyaneus* in media containing lithium salts—A W Sellards and J Laigret The vaccination of man against yellow fever Experiments on an attenuated mouse virus prove that this virus, injected into man, produces an infection without symptoms, followed by immunity It is concluded that the vaccination of man against yellow fever can be realised

## VIENNA

Academy of Sciences, Feb 25—Otmar Eckel Radiation climate of the Kanzel Peak (Carinthia) On this peak, which is 1474 metres above sea-level, the total intensity of the solar radiation reaches 1 gm-cal per sq cm per minute for comparatively low elevations (below 20°) of the sun and, in the middle of the year, amounts to 1.41 at midday The total radiation throughout the year, during which 2165 hours of sunshine are recorded, is among the highest observed in Central Europe In comparison with the thermal radiation of the sun, the ultra-violet radiation of the sun and sky depends very largely on the height of the sun, the total solar ultra-violet radiation on a horizontal surface during a day in July being fifty times as great as on a January day—Karl Mayr Definite integrals and hypergeometric functions New propositions concerning the zero positions of Bessel functions, representations of definite integrals by hypergeometric functions of high order, and relationships between the latter, are deduced—Ernst Spath and Otto Hromatka Dehydration of sapogenin, constitution and synthesis of sapotalin Dehydration of the sapogenin of *Gypsophila* (alb-sapogenin) yields, besides sapotalin, a series of hydrocarbons of high boiling points By a method of synthesis, sapotalin is shown to be 1,2,7-trimethylnaphthalene—Leopold Schmid and Rudolf Falke Action of sodium trityl on inulin in liquid ammonia This reaction gives rise to parabenzhydryltetraphenylmethane in good yield—H Wieseneder Petrographic-geological studies in the Lower Tauern Mountains—Emil Abel and O Smetana The periodate potential In relation to the normal hydrogen potential, the normal potential  $\text{IO}_4^- \rightarrow \text{IO}_3^-$  is  $1.51 \pm 0.01$  volt at 25° The energy relationships for a number of periodate reactions are deduced—Kurt Godel The intuitionistic calculus of expression

March 3—Leopold Schmid and Erwin Kotter Chemical investigation of *Verbascum* flowers The pigment of these flowers is a glucoside of  $\alpha$ -crocin and is accompanied by a dibasic acid,  $\text{C}_{14}\text{H}_{28}(\text{CO}_2\text{H})_2$ , which melts at 124° and has been isolated also from *Thapsia* root—Walter Knapp The action of *o*-phthalyl chloride on the methyl ethers of  $\beta$ -naphthol and of  $\beta$ -thionaphthol In this action the phthalic acid residue enters at the 1-position of the naphthalene system and no formation of phthalide derivatives is observed From the phthaloyl-acids further condensation products, containing a seven-membered ring, are formed—Gerhard Kirsch and Fritz Rieder. Resonance positions of the beryllium nucleus

## Forthcoming Events

## FRIDAY, JUNE 17

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5 —Prof Max Planck The Concept of Causality in Physics (Guthrie Lecture)  
ILLUMINATING ENGINEERING SOCIETY (Annual General Meeting) (at Royal Society of Arts), at 7 15 —Sir Francis Goodenough Presidential Address

## MONDAY, JUNE 20

ROYAL GEOGRAPHICAL SOCIETY (Annual General Meeting), at 3 —Presidential Address, etc

## TUESDAY, JUNE 21

ROYAL SOCIETY OF MEDICINE, at 5 30 —General Meeting of Fellows  
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30 —A T Hopwood The Oldway Expedition (Lecture)  
BRITISH WATERWORKS ASSOCIATION (Annual General Meeting) (at Bournemouth) (continued on June 22 to 25)

## THURSDAY, JUNE 23

ROYAL SOCIETY OF MEDICINE (Urology Section), at 5 30 —Sir John Thomson-Walker Some Changes and Problems in Urology (Address)

## SATURDAY, JUNE 25

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (Annual Provincial Meeting) (at Alton)  
JOURNÉES MÉDICALES DE BRUXELLES (at Brussels) (continued on June 26 to 28)

## TUESDAY, JUNE 28

NATIONAL PHYSICAL LABORATORY, TEDDINGTON, at 3 —Meeting of the General Board of the Laboratory

## Official Publications Received

## BRITISH

The Reaseheath Review a Journal of Cheshire Agriculture Vol 4 Pp 88 (Nantwich Cheshire School of Agriculture) 2s  
The Hannah Dairy Research Institute Bulletin No 3 The Properties of Milk in relation to the Condensing and Drying of Whole Milk, Separated Milk, and Whey, a Review of Existing Knowledge By Dr L A Allen Pp 159 (Auchincruive) 4s 6d net  
Seasonal Forecasting Meteorology as a Branch of Astronomy Proofs of Solar-Terrestrial Connection as a Factor in Seasonal Weather Forecasting, Presidential Address to the Queensland Astronomical Society, 8th July 1931, by the retiring President, Inigo Jones Pp 10 (Brisbane)  
Stonyhurst College Observatory Results of Geophysical and Solar Observations, 1931, with Report and Notes by the Director, Rev E D O'Connor Pp vi+46 (Blackburn)  
The Journal of the Royal Agricultural Society of England Vol 92 Pp 8+448+clxxi+xi+14 (London John Murray) 15s  
Proceedings of the Royal Society of Edinburgh, Session 1931-1932 Vol 52, Part 1 Calendar of Hume MSS in the Possession of the Royal Society of Edinburgh By J Y T Greig and Harold Beynon Pp 138 11s 6d Vol 52, Part 3, No 12 Isohedral and Isogonal Generalizations of the Regular Polyhedra By Prof D M Y Sommerville Pp 251-263 1s Vol 52, Part 3, No 13 The Genetic Basis of Alkaptonuria By Prof Lancelot Hogben, R L Worrall and I Zieve Pp 264-295+6 plates 4s (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd)  
Harper Adams Agricultural College, Newport, Shropshire Pp 72 Advisory Report No 7 Report of the Advisory Departments, 1931-1932 Pp 30 (Newport)  
Transactions and Proceedings of the Royal Society of South Australia Vol 55 Edited by Prof Walter Howchin, assisted by Arthur M Lea Pp ii+210+8 plates (Adelaide)  
The Lister Institute of Preventive Medicine Report of the Governing Body, 1932 Pp 27 (London Lister Institute)  
The Royal Society for the Protection of Birds Forty first Annual Report (January 1st to December 31st, 1931) with Proceedings of Annual Meeting, 1932 Pp 54 (London)  
Department of Scientific and Industrial Research Building Science Abstracts Vol 5 (New Series), No 4, April Abstracts Nos 576-746 Pp 109-140 (London H M Stationery Office) 1s net  
Empire Cotton Growing Corporation Report of the Administrative Council of the Corporation submitted to the Eleventh Annual General Meeting on May 26th, 1932 Pp ii+80 (London)  
Memoirs of the Cotton Research Station, Trinidad Series A, Genetics, No 3 (a) Reversal of Dominance in the Interspecific Cross *G. Barbadense* Linn x *G. Hirsutum* Linn and its bearing on Fisher's Theory of Dominance, by S G Harland, (b) The Inheritance of Chlorophyll Deficiency in New World Cottons, by S G Harland, (c) "Crumpled," a New Dominant in Asiatic Cottons produced by Complementary Factors, by J B Hutchinson Pp 31+3 plates (London Empire Cotton Growing Corporation) 2s 6d

Journal and Proceedings of the Asiatic Society of Bengal New Series, Vol 25, 1929, No 3 Pp cxi 5 14 rupees New Series, Vol 26, 1930, No 1 Pp 417 10 2 rupees (Calcutta)  
Commonwealth of Australia Department of Defence The Laboratories of the Munitions Supply Board Pp 20 (Melbourne H J Green)  
The Journal of the Board of Greenkeeping Research Vol 2, No 6, Spring 1932 Pp 161-222+xxvii (Bingley St Ives Research Station) 2s 6d  
The Australian Journal of Experimental Biology and Medical Science Vol 9 The Robertson Memorial Volume Edited by Sir Charles Martin and Hedley R Marston Pp v+246 (Adelaide The University)  
Bulletin of the Madras Government Museum New Series, Natural History Section, Vol 3, No 2 The Hydromedusae of Madras By M G K Menon Pp 36+3 plates (Madras Government Press) 1 2 rupees

## FOREIGN

Science Reports of the Tokyo Bunrika Daigaku, Section A Nos 15 19 Über die Reflexion des Diracschen Elektrons an einem Potentialanstieg, von Kwai Umeda, Estimation of Temperature of Exploded Aluminium Vapour by means of an AII Emission Band, by Hideo Nagashima Pp 293 225+plate 13 30 sen Nos 20 21 On the Zero Points of a Limited Function, II, by Soichi Kakeya, On the Star shaped Representation of an Analytic Function, by Soichi Kakeya Pp 227-240 20 sen (Tokyo Maruzen Co, Ltd)  
U S Department of the Interior Geological Survey Water Supply Paper 638 C, Outline of Methods for Estimating Ground-Water Supplies By Oscar Edward Meinzer (Contributions to the Hydrology of the United States, 1931) Pp ii+99 144 10 cents Water-Supply Paper 662 Surface Water Supply of the United States, 1929 Part 2 South Atlantic Slope and Eastern Gulf of Mexico Basins Pp vi+178 10 cents Water-Supply Paper 685 Surface Water Supply of the United States, 1929 Part 5 Hudson Bay and Upper Mississippi River Basins Pp v+147 25 cents Water Supply Paper 686 Surface Water Supply of the United States, 1929 Part 6 Missouri River Basin Pp ix+290 50 cents Water Supply Paper 690 Surface Water Supply of the United States, 1930 Part 4 St Lawrence River Basin Pp v+125 25 cents Water Supply Paper 703 Surface Water Supply of the United States, 1930 Part 8 Western Gulf of Mexico Basins Pp v+131 25 cents Water Supply Paper 707 Surface Water Supply of the United States, 1930 Part 12 North Pacific Slope Drainage Basins A Pacific Slope Drainage Basins in Washington and Upper Columbia River Basin Pp vii+196 35 cents (Washington, D C Government Printing Office)  
Svenska Linne sällskapetets Årsskrift Årgång 15, 1932 Pp v+164 (Uppsala)  
Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan Vol 32, Part 3 Studies on the Effect of Fat soluble Vitamin upon the Growth of some Parasitic Fungi By Yoshihiko Tsuchida and Mutsuo Terui Pp 71 107+2 plates (Tokyo Maruzen Co, Ltd)  
Sveriges Geologiska Undersökning Ser C, No 373 De svenska hogmossarnas geologi, deras bildningsbetäckelser, utvecklingshistoria och utbredning jämte sambandet mellan hogmossbildning och forstamning Av Eric Granlund Resumé Die Geologie der schwedischen Hochmoore, ihre Bildungsbedingungen, Entwicklungsgeschichte und Verbreitung, sowie der Zusammenhang von Hochmoorbildung und Versumpfung Pp 193 400 kr Ser C, No 374 Über den sogenannten Eisenanthophyllit der Eulysite Von N Sundius Pp 8 0 50 kr (Stockholm P A Norstedt and Soner)  
Bulletin of Yale University Twenty-eighth Series, Supplement Report of the Director of the Peabody Museum for the Academic Year 1930-1931 Pp 30 (New Haven, Conn)  
Transactions of the Connecticut Academy of Arts and Sciences, Vol 31 The Cephalopods of the Bighorn Formation of the Wind River Mountains of Wyoming By A K Miller Pp 193 297+31 plates (New Haven, Conn) 2 75 dollars  
Bulletin of the Michigan College of Mining and Technology New Series, Vol 5, No 3 Announcement of Courses, 1932-1933 Pp 147 (Houghton, Mich)  
U S Department of the Interior Geological Survey Bulletin 832 The Crystal Cavities of the New Jersey Zeolite Region By Waldemar T Schaller Pp viii+90+32 plates 45 cents Bulletin 836 C Surface Water Supply of Southeastern Alaska, 1909-1930 By Fred F Henshaw (Mineral Resources of Alaska, 1930) Pp iv+137-218 10 cents Professional Paper 169 Geology and Ore Deposits of the Bonanza Mining District, Colorado By W S Burbank With a Section on History and Production, by Charles W Henderson Pp ix+166+35 plates 2 dollars (Washington, D C Government Printing Office)  
R Osservatorio Astrofisico di Catania L'attività del sole nell'anno 1931 Pp 13 (Catania)  
Memoirs of the College of Science, Kyoto Imperial University Series A, Vol 14, No 6, November 1931 Pp 251 335 1 80 yen Series A, Vol 15, No 1, January Pp 42 1 00 yen Series A, Vol 15, No 2, March Pp 43 122 1 80 yen (Tokyo and Kyoto Maruzen Co, Ltd)  
Scientific Papers of the Institute of Physical and Chemical Research Nos 359 365 Ultra Violet Absorption Bands of Sodium Vapour, by Masamichi Kimura and Yōichi Uchida, On the Emission of Yellow-Red Band Spectrum of Sodium, by Masamichi Kimura and Yōichi Uchida, The Nature of Light Absorption by Crystals and an Optical Method of Determining the Heat of Sublimation, by Masamichi Kimura, Energy Levels of CdI<sub>2</sub> Molecule and the Relation between the Absorption Frequencies of the Substance in the States of Vapour and Crystal, by Masamichi Kimura, Absorption Spectra of certain Triatomic Molecules and their Dissociation Products, by Masamichi Kimura, The Absorption Spectra and certain Thermo Chemical Constants of Lead Halides, by Masamichi Kimura and Yōichi Uchida, A Consideration of the Emission of the Auroral Green Light in the Night Sky, by Masamichi Kimura Pp 109-176 (Tōkyō Iwanami Shoten) 55 sen  
U S Department of Agriculture Circular No 221 The White Pine Weevil By H J MacAloney Pp 31 Farmers' Bulletin No 1670 Hydrocyanic Acid Gas as a Fumigant for Destroying Household Insects By E A Back and R T Cotton Pp ii+21 5 cents (Washington, D C Government Printing Office)



SATURDAY, JUNE 25, 1932

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## The Imperial Conference at Ottawa

THE British nation has built great hopes on the Ottawa Conference. The politicians impress us with its importance, though no one seems to have any very clear idea as to what exactly is going to be achieved there. The British Empire is one in speech, in sentiment, and in ideals, but for a number of reasons, some of which are geographical those principles so important to trade and industry which are implied in the term 'Imperial preference' have so far found only partial recognition. The grievous problems which afflict the world to-day cannot be solved by the application of the old remedies; they demand totally new methods of approach and the use of scientific fact and thought. When all is approaching chaos it is for Britain to initiate the recovery, a task which alone may well be too much for the nation, but with the aid of our far-flung Empire the possibilities of success will be infinitely greater.

Nationalism, which at one time was esteemed a virtue, has under existing conditions become very nearly a vice. World trade is gradually ceasing to be, the machinery of international credits and payments has all but come to a standstill. At a time when it is most necessary to increase world trade, and the free interchange of raw materials and manufactured articles is essential, each nation is enacting measures to restrict the purchases of its peoples to home-produced articles, being forced to do so by the pressure of increasing unemployment. Increasing taxation—now beyond the bearable maximum—is merely forcing greater personal economies and aggravating the disease. The sequence of oppressive factors can only be broken by the reopening of world trade by a unit which is big enough to reverse the march of events. One such unit—the British Empire—comprises a quarter of the population of the world, and a like proportion of its area. In the main the Dominions and the Colonies are still producers of raw materials, they still contain vast areas awaiting colonisation and development. The mother land is a manufacturing country importing the necessary raw materials. If we deal only, or mainly, within the Empire, trade may be set going again, British ships will cross the seas, and the railways at home and in the Empire will carry goods from the ports to the manufacturing and consuming centres. It is true that trade will be diverted from the foreigner and to his detriment, but the disadvantage will only be temporary if the wheels of commerce can be set to revolve again in so large a unit as the Empire, for

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their momentum will soon begin to draw in other nations who are prepared to trade on a sterling basis

Such is the idea, simple enough in plan but difficult enough in practice, owing to all that has gone before. The question must be approached at Ottawa with full consciousness of its seriousness. The old habit of bargaining must be suppressed and for it substituted the principle of what each can contribute. What is required is not a political or a trade conference, but something much more akin to a scientific meeting at which the ascertained facts are laid on the table and the delegates proceed to make the best possible use out of them. Those who go to Ottawa with executive powers must be instructed to achieve success and not to be content with upholding vested interests, wherein success is defined as the agreeing of measures beneficial to the British Empire and not to any section of it. Sacrifices there will be, but it should be possible to make them of a kind which in the shortest time will prove to be beneficial. The confusing theories of economics, the fetish of gold, must be banned from the discussion. There is opportunity and great need withal for new men, new methods, to lead the Empire back to prosperity. The omens are good. The facts have been collected, industry by industry, well ahead and transmitted by the British Government to the Dominions for study, and it should be possible after broad principles have been willingly and quickly agreed, to get down to details in each industry separately. The Government delegation is a political one, but it includes three special trade advisers, namely, Lord Weir representing the Federation of British Industries, Sir Gilbert Vyle for the Chambers of Commerce and Sir Alan Anderson for the Chambers of Shipping, together with two representatives of agriculture and two labour delegates, making seven industrial advisers in all.

It is open for any industry or trade to send its own representatives to Ottawa, in fact, the Federation of British Industries is advising industries to do so, and it is known that most of the industrial associations are sending expert delegates so that there will be someone at hand to reply without delay to technical questions. It should thus be possible to set up some simple and permanent machinery, both to lay the foundations and erect the superstructure of Empire trade.

The industrial delegates have been organised as a committee by the Federation of British Industries under the chairmanship of Mr W J U Woolcock, for the purpose of co-operating with the three official representatives of business at the Congress. It is realised by industry that it must do something

more than merely wait for the outcome of the political conversations, and there is a widespread movement on foot for each industry to get together with its opposite number in each of the Dominions so as to establish such measure of agreement and effective co-operation as is possible. So far as Canada itself is concerned, wheat and timber are probably the most important items for discussion, on the other hand, British industries are able to supply most of what is now drawn from the United States.

If the whole matter be regarded from a more detached and scientific point of view than is customary for either industrialist or politician, it would seem that there is at least an opportunity for much wider questions to come under review during the discussions. Every thoughtful business man who is engaged in management knows that stabilisation, planning, orderly procedure, prudence, and the adjustment of production to demand, are necessary to keep the economic machine of his own business running steadily and efficiently. Such considerations seem to be forgotten when the unit becomes part of an industry or of the State itself. Here the individualistic creed has asserted itself, and the Darwinian principle of the survival of the fittest prevails. If we believe that there can be too much individualism in the present social organisation, that this creed is principally responsible for the distress in which western civilisation finds itself, then we have to discover how much planning is necessary, by whom it can be done, and what limitations must be imposed. If, however, we take the contrary view and advocate more individualism, smaller units, and abolition of Government interference in any form—in short, a return to the conditions of fifty years ago—then the responsibility of finding work for the nation under the entirely altered world conditions is a heavy one. At Ottawa the first doctrine will be in the ascendant, one of co-operation, of planning so as to ensure the resources of the Empire in men, machinery, and materials being used to the best purpose. The fact that the Conference is under Government auspices, and that definite legislative action to help trade is expected to be its outcome, involves also some measure of control over the planning and its consequences.

Everything depends on the good will of the participants to find a successful solution of the urgent problems, and on their courage to act constructively. Without this, indeed, the hopes of the nation will prove to have been built on a foundation of shifting sands.



## Higher Chemistry for Schools

- (1) *Physical Chemistry* By Arthur Sutcliffe Pp vii + 373 (London John Murray, 1931) 6s net
- (2) *Inorganic and Theoretical Chemistry* By Dr. F Sherwood Taylor Pp xii + 818 + 19 plates (London William Heinemann, Ltd, 1931) 12s 6d
- (3) *Inorganic Chemistry a Textbook for Colleges and Schools* By Dr E J Holmyard Pp xii + 576 + 10 plates (London Edward Arnold and Co, 1931) 6s 6d

(1) **M**R SUTCLIFFE, formerly of the County School at Cambridge, and now headmaster of the City School at Lincoln, has written an attractive book on physical chemistry for sixth form students. The book appears to have been written in response to a real demand for a description, in the simplest possible terms, of the elements of this branch of chemistry, but it is not certain that a separate volume is the best way to meet this demand, in view of the wide extent of the overlap with 'general' inorganic chemistry—an overlap which happily does not occur when the elements of organic chemistry are segregated in a separate volume.

In the present instance, the first six chapters, representing nearly one-third of the text, are given up to a duplication of work that must in any event be included in a course of elementary general chemistry, and very little of it is beyond the scope of a book on inorganic chemistry for sixth form classes. It may be said at once, however, that the compilation of these chapters, and of those which deal with the more familiar branches of physical chemistry, has been very well done, since the author has taken trouble to establish contacts either with first-hand reports on the literature or with the literature itself, as in his citation from Wollaston's paper on "Super-acid and Sub-acid Salts."

The less familiar and more modern sections of physical chemistry are handled in a much less satisfactory way. It is, for example, unfair to a schoolboy to introduce him to a neon atom with eight planetary electrons in a common orbit, and the use of a cubic octet is even more dangerous, since it is in flat contradiction with the tetrahedral configuration of carbon atoms in the diamond, and is here illustrated by a diagram of the electronic structure of sodium chloride, which is definitely misleading. The 'modern form' of the periodic classification of the elements is also incorrect, since it ignores the Rydberg series, assigns only one

element instead of two to the first group, and couples zirconium with cerium instead of with hafnium.

Similar difficulties have arisen from the rapid development of the theory of complete ionisation of strong electrolytes, which has upset so many traditional notions. There is no difficulty in describing the properties of electrolytes in simple terms, which are in strict accord with modern views, but this has not been done, and little good can result from including Arrhenius's theory in a course of school chemistry in the form in which it is here presented. Whilst, therefore, the less ambitious sections can be commended without reserve, the more modern sections are less satisfactory and tend to decrease rather than to increase the value of the book.

(2) Dr F S Taylor's "Inorganic and Theoretical Chemistry" is a well-produced book and is published at a very reasonable price. Attention is at once attracted by the maps inside the covers, which illustrate the distribution of raw materials, and by the nineteen full-page plates. These include pictures of the laboratories of Faraday, of Lavoisier, and of an alchemist (from the picture by Pieter Breughel), followed by ten pictures of crystals, luxuriously displayed on separate pages, three micrographs of steel, and a few miscellaneous illustrations.

Two founts of type are used, since the sections in large type are intended to cover the course which the student would follow in the first year or eighteen months after matriculation, whilst the smaller type is intended to provide for scholarship candidates—or for second year students at the university, who are apparently expected to repeat the work done by scholars during a final year at school. This contingency is by no means impossible, in view of the way in which scholarship candidates are kept at school to the last possible moment, in order to secure a maximum of financial reward, but the claim that the book is suitable for a second year at the university is by no means clearly established, since it has obviously been written for schoolboys rather than for undergraduates.

The book opens with a single historical chapter of seventeen pages, which recalls the names of the great pioneers, and will make a pleasant impression on anyone who is already familiar with the history of chemistry, but since Scheele, Priestley, Black, and Cavendish are disposed of in about a dozen lines each, it is obvious that no serious attempt at historical detail is possible, and it is difficult to say what impression the narrative would make on a

reader who had no historical knowledge with which to supplement the bare outlines of the text

The next seven chapters are devoted to general and theoretical chemistry and are in part of an 'advanced' character. Definitions form a conspicuous feature of these chapters, but are qualified in certain cases by footnotes, which indicate how the older definitions have been modified by later discoveries. The sequence in which information should be given provides at this stage a difficult problem, and one which is, perhaps, incapable of ideal solution. Thus, it must certainly be considered a policy of convenience rather than of logic to insert a section on types of chemical change, including equations, structural formulæ, and even a definition of tautomerism, ten pages in advance of the paragraph in which symbols are assigned to the elements, and, perhaps by a mere oversight, the kilogram-Calorie is used in place of the more familiar calorie before attention is directed on the following page to the significance of the capital C.

In the chapter on "Polar Compounds in Solution" the distinction between the complete ionisation of strong electrolytes and the reversible ionisation of weak electrolytes is mentioned tentatively, but it is not used in practice, since potassium chloride is cited as an example of incomplete ionisation in solution. This chapter is, however, free from the gross contradictions which usually result from incomplete assimilation of the more modern doctrines of electrolytic conduction.

The treatment of the periodic classification is unexpectedly ambitious, since the freshly matriculated student is introduced at once to the whole array of the elements, whilst the small-type student is introduced also to elliptical orbits and to the second (but not to the third and fourth) of the quantum numbers which characterise the planetary electrons. The systematic chapters display a similar lack of compassion, since the immature student is carried remorselessly through the eight columns of Mendeléeff's table, and is expected to learn about the compounds of columbium, the oxides of vanadium, and the chlorides of tantalum before passing on to the discovery of oxygen and the preparation of chlorine. As is well known, this arrangement was tried forty years ago, when Mendeléeff's table still held the field as the best expression of the periodicity of the elements, but even then it was found to be unsuitable for general use, except for works of reference, like Mellor's "Comprehensive Treatise". Its reintroduction at the present day is a retrograde step, in view of the clear-cut classification which has replaced Men-

deléeff's pioneer efforts. It is, for example, no longer necessary to discuss whether hydrogen should be placed in 'Group I, A' or in 'Group VII, B', since the octave or octet on which this classification was founded has not yet begun to operate, and the alternation of A and B groups is now an anachronism for which no obvious justification can be found.

The author's introduction of the electronic theory of valency at an early stage has made it possible to insert a considerable number of electronic structures in the subsequent chapters. By a curious oversight, the  $>\text{SO}$  group is generally represented with a non-polar double bond and the  $>\text{SO}_2$  group with two non-polar double bonds, although a semi-polar

structure is assigned to the  $\text{>NO}$  group, on evidence that it is substantially the same in both cases. Non-polar bonds are also used invariably in formulating metallic salts, even when the ionic character of the linkage is most clearly established, apparently because the author still thinks in terms of Arrhenius, and not of Debye and Huckel.

In conclusion, it should be said that the reviewer's criticisms are to be accepted as a form of congratulation to the author, who has broken new ground in attempting to fertilise the rather arid soil of post-matriculation school chemistry by liberal applications of electronic doctrine, and has achieved a considerable measure of success in doing so.

(3) Dr Holmyard also has introduced a table of electronic structures in the second edition of his "Inorganic Chemistry", but the chapter on the structure of the atom still occupies only twenty pages and is expressed in the simplest possible terms. It therefore adds greatly to the vividness of the story, without making it too difficult to follow.

The other changes made in the new edition are generally very slight, and up to this point the original pagination is retained, although the total bulk of the book has been increased by fourteen pages. A new diagram of a reverberatory furnace has been added, and the old picture of Berzelius has been replaced by a new one, with a balance on the table by his side, but the 'rocker' form of cell for making electrolytic alkali is still retained. A paragraph and a question in reference to hydrogen ion concentration have been added to the chapter on the ionic theory, and a reference to the "Boulevard des Italiens" illuminates the reference to neon lamps.

The elements are discussed systematically in the order of Mendeléeff's table, but this is not a bad

arrangement to use at this relatively elementary stage, since the rare earths and most of the less common transition elements are not cited in the text, although they are mentioned in the titles of the chapters, and most of the others are relegated to the last eighty pages of the book. It is, however, incorrect to limit the term 'transition elements' to the elements of Group VIII, and a similar error, which has not been corrected in the new edition, is found in the Periodic Table itself, where the rare earth elements are placed in Group IV, as if they were quadrivalent, instead of being obstinately trivalent in nearly every case. The classification of hydrogen is also discussed on old-fashioned lines, with the help of a table, which implies that the alkali metals are exclusively monatomic, and with the object of deciding whether hydrogen may be classed "with the halogens" or even "as a halogen", instead of frankly accepting the natural consequences of its unique atomic structure.

The author is, however, to be congratulated on having brought his book up to date with so little change in size or contents, and he would certainly be ill-advised to make any more drastic changes, in view of the success which he has achieved by his original presentation of the subject.

### Physics in the Séance Room

*Les pouvoirs inconnus de l'esprit sur la matière*  
Par Dr Eugène Osty et Marcel Osty Pp 153  
(Paris Félix Alcan, 1932) 25 francs

THE Institut Métapsychique in Paris is an organisation founded for the purpose of investigating psychic phenomena, and in the brochure before us we have a summary of the records of a series of séances held at the Institute. The subject of the inquiry was the young Austrian medium, Mr Rudi Schneider, concerning whom acute controversy has raged for nearly seven years. As in the case of his brother Willi, the most amazing phenomena are reported to occur in his presence, such as the movement of heavy objects without normal contact, the materialisation of human limbs exhibiting all the attributes of life, and many other similar manifestations. The means taken by the investigators to prevent fraud on the part of both mediums have usually been sufficient to exclude their active participation in the more striking phenomena observed, and certain of the investigators have found some difficulty in explaining what they have witnessed in terms of the normal. Indeed, after the recent London sittings one well-known psycho-therapist published a

letter declaring that he had experienced a strong feeling of some mysterious power working from within the cabinet, a power for which he could imagine no "mechanical or pneumatic contrivance."

In the present volume will be found further records which claim to demonstrate the mental control by the medium of some invisible substance at a distance from him, but apparently connected with some obscure form of externalised energy.

Before dealing with these claims, it may be significant to remark that Dr Osty and his collaborator, although they print two pages of anecdotal matter dealing with the biography of the medium, fail to make any reference to certain well-known facts in his history which might throw light on the *modus operandi* of Mr Schneider's more startling manifestations, and which might possibly help in elucidating the nature of that contrivance which appeared to puzzle certain of the London observers. Had these realised the true nature of the problem underlying the Schneider mediumship, they would scarcely have written as they did, for the history of the Schneider brothers is one of the most extraordinary in the annals of psychical research.

So early as 1924, Profs Meyer and Przibram, of Vienna, declared that Mr Rudi Schneider had surreptitiously freed a hand during a sitting, and the statement led to much heated discussion. In 1925, Dr E J Dingwall put forward the theory that confederacy was quite possibly responsible for many of the more striking phenomena produced by the Schneiders, a suggestion followed up in 1926 by Mr Warren J Vinton, who later published a statement that he had felt the confederate crouching behind the medium's chair. Again, in 1927, Mr Malcolm Bird, at that time an official of the American Society for Psychical Research, asserted that he had noticed that the 'materialised' hand was furnished with a normal sleeve, and further, he printed a full account of how in his opinion, the confederate was smuggled in and out of the séance room. In the same year, Dr Walter Prince, of Boston, arranged for a series of sittings with Mr Schneider in Stuttgart, at which the active assistance of a concealed confederate was excluded. Thereupon not one of the more startling phenomena occurred, and both Dr Prince and his collaborator, Mr R Lambert, came to the conclusion that there was no good reason to suppose that any of the manifestations were genuine. In 1929, 1930, and again this year, Mr Rudi Schneider was in London

under the auspices of the National Laboratory of Psychical Research. In the earlier series, startling phenomena were recorded. Human limbs and 'terminals' were observed, 'entities' touched and even brushed past the investigators, and at the end of one of the most extraordinary sittings a match-box, containing some stale matches and unclaimed by anybody, was found near the cabinet! Moreover, during the sittings this year similar wonders have been recorded, if we can judge from the interviews given to the Press by certain of the investigators.

Such in brief are a few of the facts in the life of Mr. Rudi Schneider which are omitted by the authors of this book, facts which have to be considered in any examination of the claims now put forward on his behalf, namely, that in the trance state he is able to externalise a 'force' or form of matter, which can be controlled at a distance by him, and the presence of which can be demonstrated by suitable physical apparatus.

The evidence adduced in support of this claim is derived from an ingenious use of a simple installation whereby infra-red rays are directed upon a certain area and thence to a sensitive cell. After amplification, the current finally passes to an electromagnet, which is so arranged that, if any diminution of the current occurs due to any interruption in the infra-red field, a photograph is taken by flashlight or a bell rung. In later sittings, registration of the phenomena was obtained on photographic paper, this recording time intervals, direction signals, interruptions in the infra-red, and chart of the hyperpnea of the medium in the trance state. Although certain objects were reported as being moved supernormally, this, unfortunately, did not occur when the apparatus was linked up with the cameras, although plates were exposed several times through apparent interruption in the infra-red which induced the flash. In these cases nothing was recorded on the plates which explained how the flash had been set off, the objects on the table under the infra-rays being in the same position. It seemed as if the field were being invaded by some invisible substance, and it was shown how this interruption was under the control of the medium, whose trance personality indicated to the observers when it was to take place, and permitted them to give the signals in order to demonstrate the purposive nature of the phenomena. Moreover, the respiration of the medium, which, in normal state, was of a frequency of about 12 to 14 per minute, increased in the trance state to rates ranging from about

180 to 400. This hyperpnea, so Dr. Osty surmises, is connected in some way with the externalisation of the 'force' which, he is convinced, is responsible for the results, and which in the photographic charts is seen to be connected with respiratory changes.

For reasons which seem scarcely adequate, Dr. Osty omits to give the names of many of his collaborators, and no independent testimony is brought forward to confirm his findings. Since it is clear that the experiments can scarcely be independently verified without the medium, it was all the more incumbent upon the observers to invite additional assistance from trained physicists of established reputation, for not only is it impossible to repeat the experiments in the absence of the subject, but it is equally impossible to criticise them from published accounts and rough drawings. If Dr. Osty's experiments with Mr. Rudi Schneider prove in truth that the human organism in certain states is capable of affecting matter at a distance, then they are obviously of great importance and deserve the most rigorous scientific scrutiny. The present method of psychical researchers is, however, seemingly to avoid that independent examination which is essential to the verification of their claims. It is so common as to be almost universal, and its significance can scarcely fail to be apprehended.

### Methods of Birth-Control

*The Practice of Contraception: an International Symposium and Survey.* Edited by Margaret Sanger and Dr. Hannah M. Stone. From the Proceedings of the Seventh International Birth Control Conference, Zurich, Switzerland, September 1930. Pp. xviii + 316. (Baltimore, Md. The Williams and Wilkins Co., London. Bailière, Tindall and Cox, 1931.) 21s net.

THE urgency of the need for the spread of the knowledge of the means of birth-control is forcing itself more and more on the attention of the public. In these days of sentimental philanthropy, it required courage on the part of Sir Arthur Keith to remind us that war was Nature's pruning knife and the only ultimate means of deciding that the superior race should survive rather than the inferior one. This is only another way of saying that the fundamental cause of war which cannot be dispelled by argument at Geneva, is population pressure. No nation bursting with a rapidly increasing population will allow the question of whether or not it may expand into new territories to be settled for

it by a group of other nations. All those, therefore, who desire peace must strive for the spread of birth-control.

Increasing population does not necessarily mean an increase in the birth-rate. In European countries it means an increase in the *survival-rate*. How great that has been will be seen when we reflect that, exactly a hundred years ago, out of all the children born in London three-quarters died before they were five years' old. The decrease in the death-rate of children has been due chiefly to the efforts of those imbued with humanitarian sentiment. These efforts, intended to add to human happiness, have actually added to human misery, since they have led to the production of large families by the parents least able financially or morally to support them. The only real charity which attacks the evil of poverty at its roots is teaching poor people the methods of birth-control, as Dr Drysdale is reported as saying in the volume which is the subject of this review.

The book consists of a detailed report of the seventh international conference on birth-control, which was held at Zurich in 1930. The author, Mrs Sanger, may be justly termed the heroine of the birth-control movement. Born in New York as a member of a large family of restricted means, she learnt early what the struggle to provide daily bread involved. She took up the profession of district nurse in a poor quarter of New York and her early impressions were deepened, she flamed with just indignation against the make-believe of professional religion and professional medicine. A poor woman among her patients was warned after a difficult birth that another pregnancy would be fatal. When she asked the doctor how to avoid it, he became jocular. The pregnancy duly arrived, and the woman died. On the night of her death, Mrs Sanger tore off her nurse's uniform and decided to devote the rest of her life to the spread of birth-control knowledge. She braved the 'blue' laws of her native country and suffered imprisonment for her propaganda, but she aroused such a wave of popular enthusiasm that she was released, and never again imprisoned. She visited Europe repeatedly, and travelled to India, China, and Japan, and she was largely instrumental in starting birth-control in several countries besides her own. In this volume, however, which she has edited, her personality does not appear; she has produced a marvellous compilation of expert opinions on all methods of preventing unwanted births, from simple vaginal douches to abortion under skilled surgical supervision, as it is practised in Soviet Russia. But

Mrs Sanger herself is opposed to abortion, the chapter dealing with it is only included for the sake of completeness.

It is somewhat disappointing to learn that no single method is to be relied on absolutely, all show a certain percentage of failures, but where the evil is so glaring, a percentage of successes of seventy to eighty per cent—such as is attained by the use of the Dutch cap in Holland—is a great achievement. What is patent is that the ideal method would be the subcutaneous injection of some fluid which would either prevent the dehiscence of the egg or its capacity to unite with the spermatozoon. This method has not yet been discovered, although it appears to hover on the horizon, for we learn from Dr Baker of Oxford that if we were mice and not men it would be possible to inject a hormone which would stop the egg from ripening. But this is not possible in the case of the primates and man, owing to the different sequence of events within the ovary. It is clear, therefore, that in solving this question success will be obtained only when we have attained a far more complete knowledge of the sexual cycle in man than we at present possess, and therefore the greatest aid to the cause of birth-control would be afforded by a continuance of properly directed physiological research. E. W. MACBRIDE.

### Monkey Behaviour and Associations

*The Social Life of Monkeys and Apes*. By S Zuckerman. (International Library of Psychology, Philosophy and Scientific Method). Pp xii + 357 + 24 plates. (London: Kegan Paul and Co., Ltd., 1932). 15s net.

FEW lines of inquiry may be expected to contribute more to forging a link between the biological and social sciences than investigations upon the social behaviour of man's nearest allies. That so little experimental research upon the social behaviour of monkeys has been carried out in the country of Darwin's birth is perhaps surprising and certainly regrettable. In his new book, Dr Zuckerman, who has conducted a series of comparative researches into the characteristics of the reproductive cycle of primates during the past few years, examines the social life of monkeys and apes with the view of elucidating the relation of their habits of association to the peculiarities of their sexual physiology.

The first half of the book is devoted to the thesis that association in the primates—other than man—is primarily conditioned by two circumstances that coexist in primates alone. One is that the cyclical

activity of the sexual organs is not seasonally interrupted by a period of œstrous. The other is that the female receives the male at any stage in the ovarian cycle. From this point of view, Dr Zuckerman classifies mammals in three groups. One includes the majority of orders other than the primates. In these there is a period of œstrous interrupting a succession of periods of heat for a considerable portion of the year. Such mammals form temporary herds for the mating season, and in a few isolated cases associations determined by the nature of their available food supply. A second group, including *inter alia* the field mouse and the reed buck, breed throughout the year, but mate only at such times as the female is on heat. The species belonging to this group do not form associations. Primate associations are not conditioned by the exigencies of food supply. According to Dr Zuckerman, individuals are kept together by the absence of any discontinuity in their sexual relations. The development of this view is supplemented by an extremely lucid presentation of comparative studies upon the œstrous cycle in different orders of mammals. The existing literature on this subject is not easy to follow, and a clear exposition of the field covered by the most recent advances is difficult to find elsewhere.

The second half of the book is devoted principally to a detailed study of the way in which the sexual responses of primates influence the interrelationship of different individuals within the herd. In this section, Dr Zuckerman maintains a conservative attitude to the tendency to emphasise the similarity between the social behaviour of apes and monkeys and the social behaviour of human beings. His point of view may be epitomised in the statement that monkey society rests upon sexuality, whereas human society owes its predominant features to the fact that man is a tool-bearing animal, capitalising the resources of his tool-bearing activities through the machinery of speech. Adopting this attitude, Dr Zuckerman devotes little space to the consideration of psychological studies of the kind which Kohler and his disciples have undertaken. He rightly criticises the *Gestalt* school for constructing a new philosophy on the basis of observation of animals the history of which has not been rigidly controlled from birth.

Dr Zuckerman is one of the very few trained physiologists who have made extensive studies of monkeys in the field as well as in the laboratory. In the latter portion of his book considerable space is devoted to an eminently readable account of his field observations on baboons in South Africa and

his close association with the history of 'Monkey Hill' at the London Zoological Society's gardens. An important part of his task is to reconcile the thesis of the earlier chapters with the phenomenon of 'dominance'. In the baboon society a number of 'overlords' exercise special sexual privileges at the expense of their weaker brethren, the relationship of which to the females is one of 'clandestine promiscuity'. Grooming the fur and homosexuality play an important rôle in consolidating the family nucleus. The actual care of the young is of secondary importance in maintaining the integrity of the group. Monkeys apparently do not distinguish between dead and living individuals as objects for nursing or grooming. The author's theory of the sexual basis of monkey society is thus opposed to the view that altruistic familial responses underlie the social behaviour of the lower primates.

### Short Reviews

*The Archaeology of Somerset* By D. P. Dobson  
(The County Archaeologies) Pp. xv + 272 + 8  
plates (London: Methuen and Co., Ltd., 1931)  
10s. 6d. net

*The Archaeology of Surrey* By D. C. Whimster  
(The County Archaeologies) Pp. xiv + 254 + 12  
plates (London: Methuen and Co., Ltd., 1931)  
10s. 6d. net

(1) Mrs. Dobson's volume on Somerset in the "County Archaeologies" is the most widely general in interest that has yet been published in the series. Not only are all phases of prehistoric culture, excepting the Eolithic, represented in the finds within the county borders, but it also has, in the caves of the Mendips and the lake villages of Glastonbury and Meare, sites of quite exceptional importance for their respective periods. In Roman times the attraction of the lead mines of the Mendips made known the advantages of the country, which would appear to have been appreciated to the full. The wealth of the district in Roman remains is indicated by the number of coins which have been found, here estimated with moderation at 50,000, and by Roman villas, of which that at Keynsham is the largest yet found in Britain. The relative poverty of the area in Saxon remains is in some degree counterbalanced by the historic interest of the one important site, Glastonbury, the only site in Britain on which Christianity claims an unbroken history since its earliest introduction. Somerset's geographical features and position, of which the influence is pointedly indicated by the distribution maps of finds relating to each period within the scope of the book, give the county a special significance for the student of prehistoric culture, to which Mrs. Dobson has done full justice.

(2) Mr. Whimster's "Surrey" is also a volume of exceptional interest. This is due not so much to the number and character of the finds—indeed, Surrey would come off comparatively poorly in



certain periods if it were not for the fact that the County of London, south of the Thames, has been included in this volume—but owing to the treatment of the subject matter. The geographical and geological conditions of the county are such that their relation to culture periods is capable of being treated with exceptional lucidity. Mr. Whimster has not failed to make the fullest use of the opportunity. His diagram, not entirely original, it is true, is a remarkably ingenious piece of graphic statement, and is invaluable as a bird's-eye view of the prehistory of the county. The citation of material from outside the county boundary for purposes of comparison is fuller than it has been in the case of previous volumes, but the nature of the material, especially in the later periods, makes this almost inevitable.

*The Coloured and Colour Breeding*. By T. W. Hogarth. Pp. 54 + 12 plates. (Galashiels. A. Walker and Son, Ltd., 1932.) 6s. 6d.

If we look through genetical literature, we find very little data concerning colour inheritance in dogs. The author of this little book has outlined the history of the coloured bull terrier and gathered together nearly a hundred authentic pedigrees of bull terriers carrying white and coloured blood. 'Coloured' in bull terriers may mean brindle, black, fawn, or red, and these colours with white. The pedigrees indicate the following points: (a) the white bull terrier is not a true white, but a coloured animal inheriting a factor which inhibits the outward expression of the colour except in the nose and eyes; (b) the brindle pattern seems to be of the synthetic type, and is not a true breeding factor, though one or two individuals may exist carrying the definite brindling factor which seems to be established in certain hounds; (c) brindles bred to brindles may produce brindles, blacks, fawns, reds, or whites; (d) the white animals arising from coloured parents may be expected to breed true for white. This latter finding should go far to dispel the prejudices against breeding from such white dogs. Actually it is a means by which the frequent character of deafness in white bull terriers may become dissipated.

Mr. Hogarth has had the collaboration in two chapters of Messrs. Graham and Ritchie of the Royal (Dick) Veterinary College, and Dr. Fraser Darling of the Imperial Bureau of Animal Genetics. If Mr. Hogarth's example were followed for other breeds of dogs, we should hope to accumulate much valuable data for genetical interpretation.

*Les étoiles dans leurs courses*. Par Sir James Jeans. Traduit de l'anglais par A. Sallin. Pp. xi + 205 + 47 planches. (Paris: Hermann et Cie, 1932.) 35 francs.

THIS French translation of a well-known English book is well and accurately done. The translator makes no comment on his work beyond a mention of the fact that he has retained British measures of length, temperature, etc., and added their French equivalents, and he gives at the beginning a key to the determination of one from the other. This

is excellent, but readers to whom the statement of a figure conveys some notion of the order of accuracy implied by it will regret to find, for example, on p. 22, that 53,000 miles is equivalent to 85,287 kilometres. The translator, quite excusably, appears to have failed to recognise the source of the title, which he has translated literally. He has, however, taken the trouble to correct some of the lapses from accuracy in the English book—for example, the date of publication of Copernicus's "De Revolutionibus", at the end of Chapter 1. The printing and paper are excellent, and so are some of the numerous illustrations which form one of the most important features of the book, but others are very badly reproduced. Some are too dark—for example, Plates xvii, xx, xxx—while others, such as Plates xxvii and xxviii, through the opposite fault, are mere travesties of their English prototypes. No acknowledgments of their origin are made. With the exception of the unsatisfactory illustrations, the book can be recommended as worthy of its original.

*Impassioned Clay*. By Llewellyn Powys. Pp. v + 120. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1931.) 6s. net.

THE unknown author of "Ecclesiastes" wrote to deter others from the vanity of excessive indulgence in Oriental pleasures, all was vanity except the fear of God. Omar Khayyám, a man of simple life and desires, expounded the doctrine of ephemeral joy. "Eat, drink and be merry, for to-morrow we die." Each, it will be observed, advocated a course of life inconsistent with his individual practice. To-day we meet Mr. Powys, a self-confessed Epicurean, more consistent than the above, but less pleasant and more dangerous. Happiness is the keynote of Mr. Powys' cry—happiness at all costs, be it sensuous or sensual. He is consistent in his plea for poetry, and perhaps the most dangerous quality in this book is its rhythmic flow. All religions are counterfeits, he tells us, Christianity has ever been opposed to natural happiness. All ethical considerations are man-made, he even goes so far as to mitigate the horror of a drunkard's grave. The book is an open appeal to youth, and it is to be hoped that youth will pass it by. Mr. Powys quotes Hobbes, and a part of the quotation may, as a prayer, end this notice: "Know then that all this is but an empty store of words".

P. L. M.

*Grundriss der allgemeinen Zoologie*. Von Prof. Dr. Alfred Kuhn. Vierte, verbesserte und vermehrte Auflage. Pp. viii + 264. (Leipzig: Georg Thieme, 1931.) 13.20 gold marks.

THE "Grundriss" of Prof. Kuhn, now in its fourth edition, has become a standard textbook of zoology for medical students. It is characteristic of the modern trend in morphology that considerable space is devoted to animal parasites and to heredity. This book can be recommended to English students of zoology as a rapid means of acquiring familiarity with the German language, for the copious illustrations are simple and clearly labelled.

### The Problem of Dental Caries

THE prevalence of dental caries in civilised communities has always excited discussion as to its cause the frequent consumption of sticky sweets has been generally implicated, and their avoidance, together with the eating of fibrous fruits and a proper use of the toothbrush, recommended as a means of prevention. The experimental work of Mrs Mellanby on the relationship between diet and hypoplasia of the teeth led to the conclusion that vitamin D played an important part in tooth development, and further research indicated that there was a relationship between imperfect structure and caries in human beings<sup>1</sup>. The previous emphasis upon the deleterious action of fermenting carbohydrate in the mouth on the enamel of the teeth has therefore tended to shift to an emphasis upon the deleterious action of the food after absorption on the structure of the teeth. In brief, vitamin D is the cure for caries, rather than the toothbrush.

Interest in the problem has recently been aroused afresh by the publication of the report of Surgeon Lieut.-Commander (D) W E A Sampson upon the dental condition of the inhabitants of Tristan da Cunha,<sup>2</sup> as shown by subsequent correspondence in the columns of the *Times*. It may be of value, therefore, to consider what light the dental condition of different peoples throws upon the etiology of caries, to examine how far this evidence agrees with the results obtained in animal and human experiments, and finally to analyse briefly the possible factors involved.

Dental caries does occur in Tristan da Cunha, but the incidence is so low that it would be difficult to find any other community so perfect dentally, and this in spite of the fact that the inhabitants never clean their teeth. Pyorrhœa was only found in two people, who had not been born on the island. The diet consists of fish, potatoes, milk, and eggs, vegetables are occasionally eaten. Until recently, sugar and flour formed no part of the diet, but visiting ships now regularly leave large supplies, which, however, have not, so far, increased the incidence of caries. It may be mentioned also that all the infants are breast-fed.

The dental condition of other communities is also of interest. E Mellanby quotes the investigation of Dr William Hall carried out in Leeds in 1902 upon school children and the Carnegie Report on the inhabitants of the island of Lewis in the Hebrides<sup>3</sup>. In the first case, the teeth of Jewish children were much better than those of Gentile children of the same social standing. Hall considered that differences in dieting were responsible for this, the Jewish children ate large amounts of fish, milk, eggs, and fruit and vegetables, oil was freely used for cooking. In the second case, the children lived under bad environmental conditions and were never taken out until they could walk but they were breast-fed and later lived on fish, especially fish liver, oatmeal, and eggs. Rickets was unknown, and the adults had beautiful teeth.

Another example of the effect of diet on a people's teeth has been described in these columns<sup>4</sup> in an account of the dietary conditions of two African tribes. The incidence of dental defects in Kikuyu children, living on cereals, roots, and fruits, is 30-40 per cent, in Masai children, eating chiefly milk, meat, and blood, 7-8 per cent. The latter have a high intake of protein, fat, and calcium, the former a high intake of carbohydrate and a low one of calcium.

There is also evidence that the teeth of certain races remain in good condition only so long as a particular diet is consumed: thus, Eskimos living on walrus, seal, and fish have good teeth, but dental decay appears so soon as this diet is replaced by the one customary among civilised peoples<sup>5</sup>. Again, in Asia, caries is more prevalent near the centres of civilisation, and appears to accompany the increased consumption of refined carbohydrate<sup>6</sup>.

The general conclusion from these observations is that diet is the important factor in the etiology of caries, and that climate, hereditary influences, and oral hygiene can play only a subsidiary part. Confirmation is obtained from experiments carried out under more strictly controlled conditions. Thus, J D Boyd, C L Drain, and M V Nelson,<sup>7</sup> having observed that caries was arrested in diabetic children who were strictly dieted, tested the effect of a similar diet on normal children and obtained the same result. The diet consisted of milk, cream, butter, eggs, meat, cod-liver oil, vegetables, and fruit. Oral hygiene played no part in the arrest of caries, but unless continuous supervision over the diet was exercised it began to spread again. Bunting and his colleagues<sup>8</sup> similarly found the incidence of caries much less in children given a good diet containing milk, green vegetables, and fruit, with a minimum of white flour and sugar, than in those who used a mouth wash but were not submitted to dietary control. In the former, active caries was present in about 6 per cent and 75-80 per cent had none, in the latter, caries was active in 50 per cent and only 18-20 per cent had none.

E Sprawson has recently published evidence<sup>9</sup> that the provision of a daily allowance of raw milk—that is, milk which has never been heated above body temperature—during the period of development of the teeth, prevents the subsequent onset of caries in these teeth. The children were in institutions, and the diet contained oatmeal porridge and white flour. Many were subnormal on admission, the majority lived so far as possible in the open air.

Mrs Mellanby has recently summarised her work on the prevention and arrest of caries by the administration of vitamin D, and published a further series of cases<sup>10</sup>. The children were in an institution, and the diet was not only rich in vitamin D and calcium, but also free from cereals. Potatoes and other vegetables, milk, fat, meat, and eggs replaced bread, oatmeal, rice, and tapioca, and vitamin D was given in cod-liver oil or as irradiated ergosterol,

and was also present in the egg yolk, butter, and milk. The experiment lasted 6 months and there were 22 children in the group. The average number of teeth per child showing initiation or spread of caries was 0.37, the average number per child showing hardening of caries 4.7, and the average extent of increase of caries was 0.32. (The figures for the previous investigations, in which the diets contained cereals but were supplemented with irradiated ergosterol or cod-liver oil, were respectively 1.0, 3.9, and 1.1, and 1.4, 3.7, and 1.7.) The teeth were hypoplastic and much active caries was present at the beginning of the investigation. The diet, however, prevented almost completely the development of any new points of caries.

There is general agreement that diet is an important factor in the prevention of caries, but controversy has arisen as to its mode of action. Caries is primarily due to the acid formed in the mouth by the fermentation of stagnant carbohydrate attacking the enamel: this implies the presence of an organism (*B. acidophilus*) and stagnant carbohydrate. Caries could then be prevented by ensuring the absence of the organism and carbohydrate by proper dental hygiene, and the presence of well-formed jaws and well-arranged teeth by proper feeding and adequate masticatory exercise during the developmental period. The arrangement of the cusps of the teeth may be such as to favour or prevent the lodgment of food particles, here a hereditary factor may come into play. Immunity to caries must be distinguished from its prevention or arrest: a dirty mouth may be immune because the acid-forming organism cannot establish itself, probably owing to the bactericidal powers of the saliva.

The fact that caries can be arrested, with hardening of the exposed area, indicates that the calcification of the teeth can be influenced after eruption, by substances circulating in the blood stream, just as their calcification can be affected before eruption. These substances are derived ultimately from the food, which must therefore also influence the teeth after digestion and absorption in the intestine, and the evidence suggests that this is a more important factor than its local effect, especially since it has been shown that the structure of the teeth is closely related to the amount of caries present.

The dietary factor is, however, complex, and it appears advisable to stress the necessity of considering the proper balancing of the different constituents, as well as the necessity of examining the relationship of this factor to those of climate and race, in any discussion of the problem. It is always essential in the investigation of the influence of any one factor to keep all other factors as constant as possible, but this may lead to undue importance being attributed to this one factor, and where other factors cannot be completely controlled, as in so many dietary investigations, to neglect of the possible influence of these other factors.

The factors in diet may be briefly summarised: vitamin D, cereals, salts, especially calcium and phosphorus, the total acidity or basicity of the ash

of the diet, and its fibrous or pappy nature. These must be related to the rate of growth, the previous history of both the mother and her infant, including the duration of breast-feeding, the environmental conditions, such as exposure to sunshine and the clothes worn, and finally to the possible influences of race and heredity. A few of these may be considered in more detail. There is no doubt that cereals favour the development of caries, and that vitamin D prevents and arrests it. Some recent investigations indicating that vitamin D is not a main factor are not satisfactory evidence against the controlled experiments of Mrs. Mellanby, but rather show that it is difficult to draw conclusions when many factors are uncontrolled. H. H. Mackay and S. F. Rose compared the teeth of children who had suffered from rickets with those of a control group, of similar age and social class, who had not, and found that hypoplasia of the permanent teeth was almost confined to the rachitic group, but that the amount of caries was only slightly greater in this group than among the controls.<sup>11</sup> It is probable, however, that the rachitic group received a better diet for some time than the non-rachitic, when the rickets was diagnosed, so that afterwards these children were no worse off than the non-rachitic group. Similar results were obtained by A. F. Hess and H. Abramson in an examination of the dental condition of children who had suffered from rickets as compared with that of those who had not.<sup>12</sup> It may also be pointed out that, without strict dietary control, it is not possible to say that a diet which appears the same is actually the same, since it is well known, for example, that the vitamin D content of milk and eggs varies considerably according to the diet and environmental conditions of the cow and fowl.

In considering the balance of the dietary constituents, it is necessary to bear in mind that calcium salts are soluble in acid and that calcium may be withdrawn from the teeth, as from the bones, to neutralise excess of acid in the body, as well as to supply the foetus and infant, if the intake in the food is insufficient.<sup>13</sup>

To sum up, immunity to caries depends on the teeth being properly calcified and the mouth being immune to the growth of the acid-forming bacillus. Prevention of caries in a susceptible mouth depends on oral hygiene and especially on the regulation of the diet, with the view of increasing the resistance of the teeth. Cereals should be avoided, and a plentiful supply of vitamin D (or vitamins A and D) provided, and the diet should contain an abundance of milk, eggs, potatoes, fish, meat, green vegetables, and fruits.

<sup>1</sup> NATURE, vol. 123, p. 210, 1929.

<sup>2</sup> B.M.J., vol. 1, p. 538, 1932.

<sup>3</sup> B.M.J., vol. 1, Suppl., p. 85, 1931.

<sup>4</sup> NATURE, vol. 128, p. 326, 1931.

<sup>5</sup> M. S. Goldstein and H. B. Collins. *Science Service*, March 17, 1932.

<sup>6</sup> D. H. C. Given. *B.M.J.*, vol. 1, p. 589, 1932.

<sup>7</sup> *Am. J. Dis. Child.*, vol. 38, p. 721, 1929.

<sup>8</sup> R. W. Bunting, F. P. Hadley, P. Jay, and D. G. Hard. *ibid.*, vol. 40, p. 536, 1930.

<sup>9</sup> *Proc. Roy. Soc. Med.*, vol. 25, p. 649, 1932.

<sup>10</sup> M. Mellanby and C. L. Pattison. *B.M.J.*, vol. 1, p. 507, 1932.

<sup>11</sup> *Lancet*, vol. 2, p. 1230, 1931.

<sup>12</sup> *Dental Cosmos*, vol. 73, p. 849, 1931.

<sup>13</sup> F. W. Broderick. *B.M.J.*, vol. 2, p. 725, 1931. vol. 1, p. 588, 1932.

## Recent Advances in the Study of Enzymes

PROF R WILLSTÄTTER, of Munich, and his former pupil, Prof Waldschmidt-Leitz, of Prague, were the chief speakers at a discussion on recent advances in the study of enzymes, held by the Royal Society on June 16. Most of the contributions were primarily descriptions of particular pieces of work, so that the discussion had no formal unity. It was therefore all the more striking that the proceedings should compose so readily into a set of variations on a group of related themes, indicating quite clearly what are the main problems in current enzyme research. Lack of time cut short the beginnings of an interesting general discussion.

There was general support for Prof Willstätter's view that an enzyme consists of an active group of definite chemical constitution, with a colloidal carrier. The question of the nature of the active group is closely bound up with the study of enzyme specificity. Prof Waldschmidt-Leitz described the specificity shown among the peptidases. These enzymes, which have been separated by processes of preferential adsorption and elution from the complex mixtures of proteolytic enzymes found in Nature, are without action on native proteins, but readily hydrolyse polypeptides. They fall into three main groups. The substrate must always have a peptide linkage, but amino-polypeptidases will hydrolyse only those peptides which have a free amino-group, and carboxy-polypeptidases those with a carboxyl group, while di-peptidases will usually attack only dipeptides. The substrate is attached to the enzyme at two points—at the peptide link and at one other group, which varies with the nature of the polypeptidase. The enzyme therefore possesses two combining groups, with chemical affinities for the two groups by which the substrate is held, and so spaced and oriented that they fit in with the structure of the type of polypeptide hydrolysed. This implies rigid chemical structure at the active group of the enzyme. Little is known of the chemical nature of the substrate-holding groups in the enzyme, but similarity between the *pH*-activity curves of peptidases and the effect of hydrogen ion concentration on the combination of sugars and peptides suggests that one of the groups may be chemically related to the sugars.

Many other enzymes appear to hold their substrates at two different points. Dr J H Quastel described work he has done in collaboration with Mr Wheatley on the inhibition of enzymes by a wide range of dyes. The chemical nature of the dye greatly affects the extent of the inhibition, but in general dehydrogenases and urease are sensitive to basic dyes only, while fumarase is also poisoned by acidic dyes. Since the enzyme is protected by the substrate and related compounds from the inhibiting effects of the dyestuffs, it is probable that the toxic action is exerted at the substrate-binding groups. The active groups of dehydrogenases and of urease thus seem to be

acidic in nature, while fumarase attaches its substrate at both an acidic and a basic group. Other examples, based on kinetic evidence, were given by Prof J B S Haldane. Animal lipases were found by Murray, and bacterial dehydrogenases by Woolf, to be inhibited by excess of substrate. The data fit in quantitatively with the hypothesis that in low concentrations the substrate bridges two groups in the enzyme, but in high concentrations inactive complexes tend to be formed, in which each of the enzyme combining groups is linked with a separate molecule of substrate.

Prof Haldane showed, by a series of examples, that there is a marked correlation between specificity in an enzyme and rigidity of structure in its substrates. Specificity is confined to groups in the substrate molecule which are rigid, such as sugar rings. It never appears to extend to groups which are flexible owing to the possibility of rotation, such as saturated chains. Thus absolute specificity is found among the oxidases, but only a wide group specificity among the enzymes hydrolysing peptides or esters. It seems to follow that specificity depends on the fitting together of rigid structures in enzyme and substrate. The rigidity possessed by systems of condensed rings at once suggests this type of structure for the active group of an enzyme. For three enzymes at least, there is good evidence that the activity is associated with iron combined with condensed pyrrol rings to form a hæmatin compound.

This important recent work on the hæmatin nature of some oxidising enzymes was referred to also by Prof Willstätter. It has been shown by Hellstrom and Zeile that highly purified catalase preparations always give the same hæmatin-like spectrum, in an intensity which remains proportional to the catalytic activity through different methods of purification and of inhibition of the enzyme. Similar results have been obtained by Kuhn and his co-workers with the enzyme peroxidase. There was no challenge during the discussion to the conclusion that these two enzymes are hæmatin compounds, but doubts were expressed on the validity of the evidence in the case of a third enzyme, the *atmungsferment* of Warburg. The evidence here is also spectroscopic, but rather indirect. The enzyme, according to Warburg, functions properly only when the cell is intact, when it activates oxygen and so controls cell respiration. Oxygen uptake is depressed by carbon monoxide, and the inhibition is greater in the dark than in the light. The power of light to reverse the inhibition varies with its wave-length, and when this power is plotted against wave-length a hæmatin-like spectrum is obtained, which Warburg regards as the spectrum of the *atmungsferment*. This identification was contested by Prof D Keilin, who described his well-known work on cytochrome. He recognises three factors in cell respiration: dehydrogenases at which the hydrogen of the meta-

bolites is made available, the oxidase, identical with the indophenol oxidase, at which oxygen is mobilised, and the three hæmatin compounds, cytochrome *a*, *b*, and *c*, which act as intermediaries, becoming reduced at the dehydrogenases and re-oxidised at the oxidase. Prof Keilin identifies the *atmungsferment* with the indophenol oxidase, and finds that it differs from typical hæmatin compounds in many of its properties. There is evidence, however, that cytochrome forms a complex with the oxidase, and it is the hæmatin in the cytochrome moiety of this complex which is responsible for the spectrum found by Warburg.

Similar doubts were expressed by Dr Meldrum from rather a different point of view. Dr Meldrum has been working with Dr F J W Roughton on carbonic anhydrase, the enzyme in blood which catalyses the formation of gaseous carbon dioxide from carbonic acid in solution. They have separated it from hæmoglobin, and concentrated it to a very great extent. It is inhibited by cyanides, hydrogen sulphide, and carbon monoxide, and the CO inhibition is reversed by light. These properties in the case of the *atmungsferment* are regarded by Warburg as proofs of its hæmatin nature. But carbonic anhydrase has no trace of a hæmatin spectrum, so that the validity of Warburg's argument is rendered very doubtful.

So far, the nature of the active group of the enzyme has been considered. Prof Willstatter summarised the present knowledge of the colloidal carrier, and described recent work on the relation of the enzyme to the living cell. Enzymes are always obtained as complex colloidal solutions, and the nature of the carrier must be inferred by finding what colloids can be dispensed with. Several American workers claim that enzymes are protein in nature—Sherman with amylase, Sumner with urease, and Northrop with pepsin and trypsin. But amylase has been obtained free from protein, and Sumner's crystalline urease preparation is still active after partial hydrolysis with proteolytic enzymes. Protein-free pepsin was obtained so early as 1861. The carriers seemed to vary with the methods by which the enzyme was extracted from the cell. The properties of an enzyme bound to the cell are often unlike those of the same enzyme in solution. The cell-bound or desmo-enzymes are being actively studied in Prof Willstatter's laboratory, and it has been found, for example, that the desmo-amylase of leucocytes differs from the lyo-amylase in that it is inhibited by glycerol and is active in absence of phosphates.

The relation of the enzyme to the cell was considered from another point of view. Sir Frederick Gowland Hopkins, in his opening remarks, referred to the work of Stephenson and Stuckland on hydrogenlyase. This is an enzyme, found in *B. coli communis* and other bacteria, which catalyses the breakdown of formic acid into carbon dioxide and free hydrogen. The enzyme appears only in cultures which have been grown on broth containing formates. The substrate thus seems to have the power to influence the growing cell so as to induce in it the formation of a new enzyme. Prof A

Harden described a similar phenomenon found with yeast. Normal yeasts ferment only glucose, fructose, and mannose, but the power to ferment galactose may be acquired by yeast grown in a galactose-containing medium. The course of the fermentation appears to be completely normal, the same co-enzyme being required and the same hexose phosphates being formed as in the fermentation of the other sugars. Robison has shown that a mixture of the mono-phosphates of glucose, fructose, and mannose is formed when any one of these sugars is fermented. This suggests that the fermentation takes place through a common intermediate form. Since fructose is fermented the fastest and is the sugar of hexose-diphosphate, this intermediate is probably akin to fructose. The conversion of a sugar into the fermentable form is probably effected by an enzyme or activator specific for the sugar. Such activators may be identical with the hexo-kinase obtained by Meyerhof from yeast, and found by him to enable muscle extracts to use hexoses as a source of lactic acid. The presence of galactose in the growth medium induces the formation in the yeast of a special kinase for galactose.

A distinction between the mode of action of hydrating and oxidising enzymes was brought out in the discussion on the mechanism of enzyme catalysis. Prof Haldane pointed out that hydrating enzymes show symmetrical pH-activity curves, while dehydrogenases give curves rising from the acid side to a plateau in the alkaline region, as required by Woolf's theory. The discussion on the mechanism of enzymic hydrolysis was disappointing. Prof Waldschmidt-Leitz regards union between enzyme and substrate at two points as evidence for the two-affinity theory of Euler, according to which the substrate is bound at one group in the enzyme and caused to react by another. But there seemed to be no indication of this difference of function in the two enzyme combining groups, nor was there any discussion on how the water, which is an essential substrate in a hydrolysis, is brought into the reaction. On the other hand, the mechanism of oxidising enzymes gave rise to a lively exchange of opinion. This discussion is being continued in the correspondence columns of NATURE, so it is only necessary to give the barest summary here.

Prof Willstatter gave an account of the theory he put forward in conjunction with Prof Haber, that the substrates of oxidising enzymes leave the enzyme in the form of free radicals, which initiate chain reactions throughout the medium. Thus

ethyl alcohol would form the radicle  $\text{CH}_3 \overset{\uparrow}{\text{CH}} \text{OH}$ , which interacts with oxygen and a molecule of alcohol to form two molecules of aldehyde and the

radicle  $\text{OH} \overset{\uparrow}{\text{CH}}$ . This takes up a hydrogen atom from a molecule of alcohol, regenerating the first radicle, and so the whole cycle is repeated an indefinite number of times. Prof Haldane criticised this view. It fails to account for the proportionality between enzyme concentration and reaction velocity,

the formation of radicles like OH which react with many different substances contradicts the facts of enzyme specificity, and the theory cannot account for coupled reactions. Dr Richter objected to the idea of free radicles, and supported instead the view of Christiansen that there are chains of molecules with abnormally high energy content. Prof Willstatter replied that such activated molecules would lose their excess energy by collisions before they could enter into chemical reaction. He

admitted the force of some of Prof Haldane's arguments, and said that the formulation involving

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radicles like  $\overset{\uparrow}{\text{O}}\text{H}$  is too simple, and the mechanism must be revised in accordance with the specificity of enzyme action. But whether the chain reaction theory is finally accepted or not, it was made clear by Prof Haldane that it will be of great service in stimulating fundamental experimental work.  
B WOOLF

### Obituary

PROF J W GREGORY, F.R.S.

IN the *Times* of June 14 the brief announcement was made that a wireless message received from Iquitos had been transmitted by Reuters from Lima stating that Prof J W Gregory had been drowned in the Urubamba, near Megantoni Falls in Northern Peru. A subsequent message on the following day confirmed the report and added that Prof Gregory was drowned by the overturning of his canoe in the rapids of Pongo de Mainique in the River Urubamba. The river at this point is only 24 feet wide, the banks consisting of perpendicular rocks of immense height.

Prof Gregory left Liverpool six months ago with a small party of which Miss Mackinnon Wood was one, intending to study the geology of Peru with especial reference to earth movements in recent geological times and the connexion between them and earthquakes and volcanic phenomena. Miss Mackinnon Wood was specially interested in the collection of fossils. As no further particulars of the fate of the rest of the party have been received, it may be presumed that they have escaped disaster. The Peruvian Government afforded every facility to the expedition and is stated to have sent two Peruvian geologists to accompany them.

With the death of Prof Gregory, the most prominent and most widely known British geologist of the present time is removed from the scene. As a writer on geological topics and a lecturer to scientific meetings he had a large public, and his activities as a traveller had made his name well known not in Britain alone but in all parts of the world. He was a ready writer with an easy, fluent style, and was well versed in so many departments of geographical and geological science that his writings cover a vast range of subjects. The mere list of his published volumes is a very impressive one, without taking count of the great series of scientific papers, more than two hundred in number, which came from his pen.

To take a general view of the contributions of a scientific worker so active and so versatile is by no means easy, but we think that Gregory's greatest achievements were in the fields which form a borderland between geology and geography. He will be remembered for his explanation of the rift valleys of Africa, his exposition of the tetrahedral configuration of the earth, his brilliant contribution to the history of the Atlantic and Pacific basins which formed his presidential addresses to the Geological

Society of London, his speculations on the history of valleys and fiords, and the startling hypothesis of the deep-seated and probably volcanic origin of the artesian waters of Central Australia. His mind was constantly occupied with the greater problems of earth structure and history, and his vast erudition gave his opinions a weight which made even those who were most critical of his conclusions treat them with the respect due to profound knowledge and a strikingly original and individual outlook.

Gregory was born in Chelmsford, Essex, in 1864. His father was a wool merchant, and his son assisted him until he was twenty-three years of age. In 1887 he was appointed an assistant in the British Museum, where he served until 1900, when he was appointed professor of geology in the University of Melbourne. He returned from Australia in 1905 to become professor of geology in the University of Glasgow, a post from which he retired on pension in 1929.

At the British Museum, Gregory was engaged principally in the study of fossil Bryozoa, on which he published three volumes of catalogues well known to specialists, but at an early age the *Wanderlust* was strong in him. He visited western North America in 1891 and first attracted attention as a traveller and explorer by his journey in British East Africa in 1892-93. This showed clearly the stuff he was made of, as, in spite of discouragement, difficulty, and danger, he executed a notable piece of work, which characteristically formed the foundation of a brightly written book that thoroughly deserved the great popularity with which it was received. Afterwards he visited, on scientific work intent, almost every quarter of the habitable world. In Spitsbergen, 1896 (with Sir Martin Conway), Central Australia and Queensland (1901-4), Cyrenaica (1908), Southern Angola (1912), Rhodesia and India (several times), North America (repeatedly), and Chinese Tibet (along with his son in 1922) he collected geological information and wrote many geographical and geological papers. In 1919 he was awarded the Victoria Medal of the Royal Geographical Society, in 1922 the Gold Medal of the Scottish Geographical Society and the Galois Medal of the Société Géographique de Paris. These were only a few of the numerous honours which fell to him. He was president of the Geological Society of London (1928-30), and for the second time presided over Section C (Geology) of the British Association at its centenary meeting in London, 1931.



As a professor of geology in Glasgow, Gregory was eminently successful. He had the art of making the subject appear easy and attractive. His classes were the largest in any British university, and he trained a considerable number of students who have afterwards made their mark. Much of this success was due to his remarkable personality. No one could have been more free from assumption or arrogance. His enormous erudition, based on wide reading and a very retentive memory, was free from any kind of ostentation. He was willing to discuss his subject with all comers, however superficial or ignorant, but only those who were experts could appreciate his extraordinary range of vision and realise how much he had seen and learnt. He began his scientific work as a palaeontologist and continued through his whole life to work at that subject, but he wrote also on petrology, translated a book on mineralogy, and was recognised as an authority on mineral deposits, such as copper and gold. He was, for example, one of the first to maintain the theory of the origin of the gold mines of the Rand which now receives the support of the majority of the skilled engineers and geologists who are best acquainted with that field. He published a very useful handbook of economic geology.

My experience of a long friendship with Gregory was that it was very unwise to assume that you knew more of any subject than Gregory did. It was dangerous to differ from him in opinion, as in the quietest possible manner he would produce some devastating facts, well attested but not widely known, that would shatter premature hypotheses.

JOHN S. FLETT

#### DR J. G. GARSON

THE death occurred on June 1, at the age of seventy-seven years, of Dr J. G. Garson of Ewell Court, Surrey. Dr Garson was born in Orkney and was educated at the University of Edinburgh, taking the degree of M.B. in 1875 and of M.D. in 1878. He was admitted a licentiate of the Royal College of Surgeons, Edinburgh, in 1875. He also studied in Vienna, Berlin, and Leipzig. For many years Dr Garson was a prominent figure among anthropologists, especially in connexion with the (Royal) Anthropological Institute, of which he was for long a member of council, and the Anthropological Section of the British Association. He assisted in the revision and re-editing of "Notes and Queries on Anthropology" when a new edition of that manual was issued by the British Association in 1892.

As an anthropologist Dr Garson specialised in craniology, especially in its bearing on race in the prehistory of Western Europe, and he did much to foster in Great Britain a knowledge and appreciation of the work of Broca and other Continental anthropologists. His close association with French anthropologists and his friendship with Bertillon led him to the study of Bertillon's anthropometric methods of criminal identification, and when this method was adopted in police work in England, Dr Garson became adviser to the Home Office on the methods of identification of criminals and the

classification of their records, a position which he continued to hold until the introduction of the fingerprint system. Dr Garson was also lecturer in comparative anatomy at the Charing Cross Hospital and Swiney lecturer of the British Museum. From 1902 until 1904 he acted as assistant general secretary of the British Association for the Advancement of Science, organising the Belfast, Southport, and Cambridge meetings, and was a member of its council until the time of his death.

Dr Garson was the author of a large number of papers contributed to medical and scientific journals, and his services to anthropological studies were widely recognised on the Continent. He received the award of the medal of the French Association for the Advancement of Science in 1914, and was an honorary or corresponding member of the anthropological societies of Berlin, Moscow, Rome, and Paris. During the War he held a commission as captain in the R.A.M.C.

WE regret to learn from the *Chemiker-Zeitung* of the death on March 14 of Prof. M. A. Rakusin, of Moscow, at the age of sixty-three years. Rakusin was principally interested in the chemistry and technology of petroleum. At first a believer in the mineral origin of petroleum, his researches upon its optical activity led him to uphold the theory of its organic origin, and in 1906 he found evidence of the existence in petroleum of cholesterol. From his studies upon the opacity to polarised (though not to ordinary) light of dilute solutions of petroleum in benzene, he developed a theory of the existence of ultra-microscopic carbon particles in petroleum, from the amount of which he attempted to calculate the geological age of the deposit. In his later studies he took up the investigation of adsorption phenomena and biochemical problems. He had undertaken to prepare the section on optical activity for the new edition of the handbook "Das Erdöl".

WE regret to announce the following deaths:

Dr William Briggs, founder of University Correspondence College (1887) and also of University Tutorial College, where practical work in physics, chemistry, and biology was introduced to supplement correspondence courses, on June 19, aged seventy years.

Dr Cuthbert Christy, who travelled extensively in Central Africa and was a member of several British and Belgian commissions on sleeping sickness, on May 29, aged sixty-eight years.

Dr C. Dwight Marsh, formerly physiologist to the United States Bureau of Animal Industry, known for his work on plankton life in fresh-water lakes and the effects of poisonous plants on animals, on April 23, aged seventy-seven years.

Mr Robert E. Montgomery, adviser on animal health to the Colonial Office, on June 11, aged fifty-one years.

Dr Marcus S. Paterson, lately medical superintendent of Colindale Hospital, Hendon, an authority on tuberculosis, on June 1, aged sixty-two years.

## News and Views

### Sunset Glows and the Andean Eruptions

THE possibility that the Andean eruptions of April 10 and the following days might be followed by notable sunset glows, at least in the southern hemisphere, was mentioned in our issue of April 23, p. 604, seeing that the eruptions of Krakatoa and Mont Pelée both gave rise to such effects. A letter dated May 18 received from Mr. T. B. Blathwayt, Box 7532, Johannesburg, suggests that these have already begun. Mr. Blathwayt says "We have had them strongly in evidence the last few weeks both here and in other parts of South Africa, so that they must have begun within two weeks of the outburst in South America. There is a strong, dull red glow extending over the whole sky on most evenings, and I saw it one morning at sunrise." Inquiry at the Meteorological Office (Air Ministry) suggests that this may be the first report of phenomena of this kind to reach England. It may be noted that May is one of the dry months in the neighbourhood of Johannesburg and the weather would not normally be such as to favour the formation of sunset cloud effects; moreover, the low latitude yields short twilight, and only very high clouds would be exposed to the sun's rays for long after sunset or before sunrise. The attention of readers interested in this subject may be directed to an article in the *Meteorological Magazine* of the Meteorological Office for May, in which Dr. C. E. P. Brooks discusses the movements of volcanic dust over the globe following the Krakatoa eruption of Aug. 26–27, 1883. This paper is based largely on the Report of the Krakatoa Committee of the Royal Society, London, 1888.

### Meteorite Craters in Arabia

SINCE the general article in *NATURE* of May 28, p. 781, on meteorite craters was written, a still more remarkable discovery has been made known from the Arabian desert, which was crossed by Mr. H. St. John Philby early this year. On the site of the supposed ancient city of Wabar in the Rub' al Khali, he found two shallow craters, the larger one 100 metres across, together with indications of other craters buried in the sand. Around the craters the ground is thickly strewn with slaggy and cindery material, suggesting a volcano. Near by, a 25-lb. mass of iron together with a few smaller pieces of iron and iron rust were collected. The cindery material proves to be silica-glass and the iron is meteoric nickel-iron. Silica-glass is of rare occurrence in Nature, and this example is the most remarkable yet known, both in the abundance of the material and the variety of its forms. Most of the pieces are complete individuals or 'bombs' with a white cellular interior and a black glossy and pumplily surface, and they range in size down to 'black pearls', which were collected in considerable numbers. Such an association of silica-glass with meteoric iron around craters can be explained only as the result of the fall of an enormous meteorite or a shower of meteorites. Their energy of motion was suddenly transformed into intense heat at a very localised spot, and in the sandy desert a rain of molten silica full of bubbles was

shot out from the craters through vapours of iron and silica. The large quantity of material collected by Mr. Philby has been presented to the British Museum by H. M. the King of the Hijaz and Najd, and a selection of that from Wabar is now exhibited in a lighted wall-case near the entrance to the Mineral Gallery in the Natural History Museum at South Kensington.

### Tenth International Horticultural Congress

THE Tenth International Horticultural Congress was held in Paris on May 30–June 5, on the invitation of the Société Nationale d'Horticulture de France. Great Britain, many European States, Canada, and the United States of America were represented by official delegates. The meetings were held in the rooms of the Société Nationale d'Horticulture in the rue de Grenelle, where the delegates were received by the president of the Society, M. F. David, who was also elected president of the Congress. The papers presented were grouped in sections dealing respectively with fruit-arboriculture, genetics and soil-science, plant-diseases and their treatment, and botanic gardens—their function, organisation, and arrangement. The standing committees appointed at previous congresses met to report progress and to consider further action. The Committee on Nomenclature had for its consideration a list of generic names recommended for use in horticulture to avoid the confusion arising from the use in practice of different names for the same plant. Steps were also taken to arrange for the preparation of lists of species of the more important genera in cultivation. The names adopted would be those valid under the Rules of Botanical Nomenclature as passed by the International Botanical Congress of 1930. Interesting features of the Congress were visits to the Jardin des Plantes, the National School of Horticulture at Versailles, and to a number of horticultural establishments near Paris, including the famous nursery of Vilmorin-Andrieux et Cie, and others at Tours and Orleans. During the Congress, an "Exposition Internationale" arranged by the Horticultural Society was held in the Cours la Reine in Paris.

### Printing Mathematical Expressions

THE London Mathematical Society has recently issued a pamphlet ("Notes on the Preparation of Mathematical Papers" Pp. 19. London: C. F. Hodgson and Son, Ltd. 1s.) of suggestions to authors and others preparing mathematical script for the press. In the preparation of satisfactory mathematical print there are three points which should not be overlooked. (1) The difficulties of the compositor should not be insuperable. Whereas in the past it has often been necessary to cut special pieces of type, frequently with unsightly results, the printer is now generally able to find everything he requires in his fount. (2) The print should be easy of comprehension by the reader for whom it is intended. (3) The printer should also aim at elegance in the display of formulæ.

As an illustration, it is better to print  $\sqrt{a+b}$  than  $\sqrt{a+b}$  in a line of type, since the latter involves irregular spacing between the lines. On the other hand, the second of these expressions is more readily grasped when it can be displayed in a separate line. With the notation now in general use, almost all the symbols required in mathematical work can be so adapted as to be manageable to the compositor. It is pointed out that symbols which are necessarily awkward in appearance are fortunately rare. The present pamphlet is mainly of interest to the professional mathematician, there being no mention of the special symbols employed in such wide offshoots as actuarial mathematics. It includes a collection of the symbols which (in the eyes of a compositor) are better avoided, also a list of the symbols forming part of the stock of an up-to-date mathematical printer.

#### Science and Art in the Textile Industries

In a speech at the annual Conference of the Textile Institute at Leamington Spa on May 19, Dr S G Barker discussed the general relation of science to industry. Dr Barker cited the recent observation in physics that drops of one electrolyte in another when submitted to the action of an electric field exhibit the phenomena of lateral spreading, as an example of the truth that none can say what textile applications will follow even a remote discovery in physical science, or when and how such discoveries will be made. In regard to the concrete benefit of science to the textile industries, Dr Barker asserted that most of the work has been pioneer in character, and that good foundations once well and truly laid are rarely seen again. Unfortunately, the rapid extension of the bounds of physical science in the last decade created an inferiority complex in the minds of many ordinary individuals. The new knowledge appeared so vast and confusing that the minority of experts and investigators responsible for it were placed on a pedestal and their dicta accepted without thinking. Not only did the majority of people fail to realise the significance of the discoveries thus made, but inevitably the discoverer himself was frequently unable to recognise the social or industrial value of his discovery.

In Dr Barker's opinion, the scientific worker must endeavour to provide at the moment more practical results if, when prosperity returns, opportunity is to be afforded for the long-range fundamental researches. Only so can we hope to diminish the disparity between our mechanical skill and our social wisdom, between our power over Nature and the mentality which dictates its use. The challenge thus offered to us affords fresh opportunities for the spirit of adventure and romance which already finds expression so frequently in scientific research, and in regard to the textile industries, Dr Barker stressed the importance of linking science to art and seeking to develop products which possess the supremely important aesthetic appeal. The union of art with science should mean not the degeneration of craftsmanship, but the creation of a progeny which will be economic, utilitarian, artistic, and scientific.

#### National Parks in America

In an article in *The Christian Science Monitor* of May 13, much interesting information is given of the growth of the National Park Service of the United States, and of the projects now under consideration. The inauguration of the first national park took place some sixty years ago, but the National Park Service of the Department of the Interior was established by law of Congress, approved on Aug 25, 1916. Its objects are to promote and regulate the use of the federal areas known as national parks, monuments, and reservations, and "to conserve the scenery and the natural and historic objects and the wild life therein, and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." Mr Stephen Mather, the 'father' of the national parks, was the first director of the service, but in 1929 he was succeeded by Mr H M Albright. At the present time, the service has the administration of 22 national parks and 36 national monuments, but many others are supervised by the Department of Agriculture and the War Department.

In an interview, Mr Albright referred to the establishment of the Branch of Research and Education of the National Park Service. This has already given much attention to the natural scientific phases of the educational work, which includes the development of the means of informing visitors in the simplest way of the interesting geological and biological features of the parks. Special attention is now being given to the historic aspect. Among the most important projects now being considered are those for national parks in Virginia, Kentucky, Michigan, and Florida. The proposed Shenandoah National Park is in the Blue Ridge Mountains, Virginia, and consists of an irregular strip of virgin forest, 66 miles long and 8-18 miles wide. For the Mammoth Cave National Park the State Legislature of Kentucky has already appropriated 1,500,000 dollars for buying caves and properties in the area. The caves are said to have passages and chambers extending approximately 150 miles on different levels. The Michigan scheme relates to the wilderness area, 45 miles long and 5-9 miles wide, on the shores of Lake Superior and only a little more than twelve miles from the coast of Ontario. The area is called Isle Royale, and it is the home of large herds of moose and caribou. Of a different character is the area of 2000 square miles which it is proposed to preserve in the south and south-west of Florida. This area includes channels, lakes, and swamps bordered by groves and forests filled with tropical vegetation. Another project is to connect the eastern parks by an Eastern National Park-to-Park Highway, giving tourists approximately 2000 miles of road, nearly every mile of which runs through scenic or historic country.

#### Natural Reserves in the Belgian Congo

It is well known that the King of the Belgians has played an active part in the development of scientific institutions in his country, and that he is a keen supporter of research. Among his other interests is the question of the protection of the flora and fauna,

particularly of the tropical colonies of Belgium. So long ago as 1909, after travelling in South Africa and the Congo, he emphasised the necessity of taking measures without delay for saving a part of the fauna and flora, which intense and often unregulated economic development threatens to destroy. In the Congo in particular, this destruction was going on with great rapidity, often without apparent cause. We owe to the intervention of the King of the Belgians the creation, in 1929, of the Parc National Albert, comprising about 357,000 hectares (nearly 1400 square miles). The administration of this reserve is in the hands of a commission of which the King's son, Prince Leopold, is president, and Prof V Van Straelen, director of the Royal Museum of Natural History, Brussels, is vice-president. During last April, King Albert, accompanied by Prof Van Straelen, visited the Kivu Park in the Belgian Congo, having made the journey specially to see for himself the effectiveness of the measures of protection in force. His gesture for the cause of the protection of the fauna and flora is of high importance and should result in intensification of the efforts being made in this direction, not in the Belgian Congo alone but also in other countries.

#### • Bird Invaders in London

THE nesting of the jay in Ladbroke Square in west London, recently reported in *Cage Birds*, is certainly a marked invasion of the metropolitan area by this woodland species, but it has been present in south-east London for years past, and has regularly nested in the grounds of the Horniman Museum at Forest Hill within a few dozen yards of a main road. The curious thing is that it is this shy bird and not the bolder magpie that has colonised London, and that among the typical crows it is the carrion crow and not the building-haunting jackdaw that is the familiar London bird. The colonisation of London by birds of prey is also not in accordance with expectation, the buildings have failed to attract the barn-owl, but the tawny owl is so generally diffused that it has been heard within five minutes' walk of King's Cross Station, while, though the pigeons and ducks in London might have been expected to attract the peregrine falcon, and the sparrows and starlings the sparrow-hawk, the only hawk commonly to be seen is the kestrel, which must subsist there on birds rather than on the mice and insects which are its more usual food.

#### The Advance of Medicine

THE Romanes Lecture entitled "The Advance of Medicine" delivered at Oxford on June 1 by Lord Moynihan, president of the Royal College of Surgeons, who received the honorary degree of DCL on that occasion, has been published by the Clarendon Press (2s 6d net). After an historical introduction in which he briefly reviews the work of Hippocrates, Galen, Vesalius, the Italian anatomists, Harvey, Morgagni, and John Hunter, Lord Moynihan passes on to Lister, whom he describes as the greatest material benefactor of mankind the world has ever known. He attributes Lister's genius to the fact that he was master both of the Hippocratic method of induction

and the Galenic method of deduction, and combined the qualities of a physiologist and clinician. Lord Moynihan deplores the fact that physiology is now losing the close relationship it formerly had with clinical medicine, and urges that physiologists and surgeons should make a common attack upon "the innumerable mysteries of disease". On the other hand, he maintains that though the aid given by physics, chemistry, and physiology is indispensable, these sciences are merely ancillary to medicine, which is a science as well as an art in itself. In view of the fact that laboratory aid, though sometimes decisive or at least helpful, is not seldom negligible, the clinician must maintain his sovereignty. In conclusion, Lord Moynihan exemplifies the humanism of medicine by the work of Harvey, John Hunter, Hillman, who discovered anaesthesia, and Lister. Three appendices to the lecture deal respectively with the ideal training of the surgeon, experiments on animals, and the relation of physics and chemistry to medicine.

#### Modern Oil Production Problems

MR A BEEBY THOMPSON'S recent survey of engineering progress in petroleum production (Institution of Petroleum Technologists, May 10) showed clearly the remarkable changes which modern industrial, chiefly economic, conditions have brought about in the technique of oil mining. Only a few years ago 10,000 ft oil wells and the safe and efficient handling of pressures of 5000 lb were considered impossibilities, unit operation of oilfields, now an accepted principle, was then an unattainable ideal. The modern technique of deep drilling has brought with it a chain of difficult problems confronting oilfield engineers throughout the world. Among these may be mentioned control of flowing wells, freezing of wells as a result of rapid expansion of gas together with formation of ice actually in the well itself; mechanical extraction of oil, that is, pumping and plant to raise oil to the surface from depths of 5000-10,000 ft, involving as it does pump pressures up to several thousand pounds per square inch; crooked holes and their avoidance, air-gas lift efficiency, paraffination of wells where waxy oil is encountered, a difficulty still not satisfactorily solved, the ultimate recovery of oil from at present commercially exhausted pools; disposal of surplus natural gas, particularly in regions far removed from populous areas, and the thorny question of practicability of extending the principle of mining oil measures, as at Pechelbroun. None the less, progress in the last few years has been of such a character that one cannot but anticipate a satisfactory solution to some, if not all, of these problems in the near future, especially when economic conditions in the industry improve.

#### Street Lighting

THE improvement in modern street lighting is largely due to the appointment of public lighting engineers whose whole time is devoted to the work. They pay attention to details which have been previously overlooked or neglected. In *Electrical Industries* for June 15 there is a paper on modern

street lighting by Haydn T. Harrison which brings this out clearly. The outstanding advances took place several years ago, gas and the arc lamp being two of the earliest. The invention of gas mantles largely stopped the use of luminous gas. They also prevented the adoption of the carbon filament electric lamp. The invention of the gas-filled lamp was the last notable step forward. The rapidly increasing use of electricity for street lighting at the present time is due not so much to the efficiency of these lamps as to the fact that light can be distributed from them in any required direction by simple optical means. Hence the most notable feature of modern street lighting is the large number of electric lamps fitted with reflectors or glassware designed specially for distributing the total light most efficiently. The motor vehicle head-light is an excellent example of the adaptability of the gas-filled electric lamps. These lamps only take 20 or 30 watts—the same as a small house lamp. By suitable reflections they produce a beam of light in front of the car which enables the driver to see objects to be avoided on the road 100 yards in advance. No other commercial source of light could be made to do the same thing. In modern street and road lighting, the tendency whenever there is a change of system is to raise the height of the lamps. This improves both the illumination on the road surface and the visibility, except when the weather is very foggy.

#### Electrification of the Great India Peninsula Railway

To a joint meeting of the Institute of Transport and the Institution of Electrical Engineers on April 28, Mr. F. Lydall read a paper giving a general account of the suburban and main line electrification of the G. I. P. Railway. He compared the actual with the anticipated traffic and dealt with the design of the plant and apparatus. The electrified portion of this railway is second only in extent, within the British Empire, to that on the Southern Railway in Great Britain. The length of single track fully equipped is 571 miles, the capacity of the substation plant is 100,000 kilowatts, and there are 272 miles of 100,000-volt transmission line. It joins Bombay, a city of about  $1\frac{1}{2}$  million inhabitants, situated mainly on an island, with Northern and Central India by the North-Eastern main line and with Southern India by the South-Eastern main line. Both these lines have to negotiate the escarpment which runs roughly parallel to the coast about forty miles inland, known as the Ghats. On both sections the ruling gradient is 1 in 37. The reason given why the traffic is less than was anticipated is the world depression of trade, which affects India in general and Bombay in particular. The most prolific source of trouble in electric operation is the propensity of the crows in and near Bombay to build nests with iron wire on the overhead line structures. It is related that one such nest was built of metal spectacle-frames which had been filched by a crow from an open shop-window. During the nesting period, crows fly about with pieces of wire sometimes about a yard long in their beaks, and this naturally sometimes causes short circuits. Flying foxes also have sufficient

spread of 'wing' to hook across the mains on 20,000-volt lines. Methods to overcome these difficulties have been devised.

#### Centre International de Synthèse

THE "Centre International de Synthèse" of Paris is planning—and has already begun work on—three important vocabularies. The first is a vocabulary of the most important terms used by historians, jurists, sociologists, and economists. The second is a historical dictionary of science, considered in its relation to philosophy; it will deal with the mutual influence of philosophy and science throughout the historic periods. The third is a vocabulary which will analyse the more important scientific concepts of to-day, their origin and development, and may throw some light upon the various meanings frequently assigned to the same scientific term. The Centre International de Synthèse was formed in 1925 with the object of co-ordinating researches in various branches of pure science. It is under the direction of M. Henri Berr, and it has among its members and associates many French and foreign savants, as well as some young and active investigators. It has four sections: (1) Synthèse historique, (2) Histoire des Sciences; (3) Sciences de la Nature; and (4) Synthèse générale. These meet weekly, in rotation, and the results of their discussions and labours are published in two periodicals, *Revue de Synthèse* and *Archivon* (*Archivum di Storia della Scienza*). In addition, the Centre holds yearly international meetings (*seminaires*), during which specialists in various branches of science describe recent advances in their respective fields.

#### Literature of Food Investigation

WITH the very belated appearance of the issue for September 1931 of the index to the literature of food investigation (vol. 3, No. 2, September 1931. London: H. M. Stationery Office, 1932. 2s. 6d. net), the third volume of this abstract journal is completed. It is published twice a year from the Low Temperature Research Station at Cambridge, two numbers comprising the volume. This number contains 183 pages and a list of the periodicals read. For the benefit of those who do not know this publication, it may be mentioned that it consists of elaborated titles of papers dealing with the problems of food preservation and marketing, arranged in fifteen different sections, namely, meat, pig-flesh, poultry and game, fish, eggs, dairy produce, fats and oils, fruit and vegetables, grain, crops and seeds, theory of canning, theory of freezing and chilling, bacteriology, mycology, engineering, and finally miscellaneous. It was instituted to enable research institutions in the Empire to keep abreast of progress in preservation and transport of food, but should also be of use to all who are interested in the scientific and practical aspects of this subject.

#### The Seminoles

MISS FRANCES DENSMORE, who has recently returned to Washington from Florida, reports a somewhat unusual attitude of aloofness towards the whites and their civilisation on the part of the Seminole Indians of the Everglades. Apparently they have never become

entirely reconciled since the great Seminole wars at the beginning of the nineteenth century. Miss Densmore visited these Indians on behalf of the Smithsonian Institution, Washington, D C, with the view of the investigation of their music, and although she had been assured that the Seminoles had no songs, she was successful, in the end, in obtaining two hundred phonograph records. In a preliminary statement issued by the Smithsonian Institution, Miss Densmore says that the Seminoles are ruled by 'old men', who remain in seclusion in the Everglades and are rarely seen. A rule is imposed upon the people that they are not to learn, or at least to speak, English. Inter-course with the whites is conducted by signs, except that sometimes they will name prices for the articles they wish to sell. They pride themselves on being a full-blood tribe, and a recent count gave 17 mixed bloods only in a population of 500.

### Breeding Insects

IN a useful note in the *Vasculum* for May (p 61), Prof J W Heslop Harrison gives simple instructions for the breeding of insects for experimental and other purposes. This information about the materials used, the methods of constructing cages for moths and butterflies, and the rather unorthodox methods of wintering pupæ, should help to solve problems which have baffled willing but inexperienced experimenters.

### Announcements

PROF C G SELIGMAN, professor of ethnology in the University of London, has been awarded the Nelson Annandale Gold Medal of the Asiatic Society of Bengal for his "contributions to the study of Anthropology in Asia." This medal, which is awarded triennially, was founded in 1927, and the only previous recipient was Dr Fritz Sarasin, of the Museum für Volkerkunde, Basle.

THE KING, on the recommendation of the Minister of Health, has approved the appointment of Miss Ruth Darwin as a senior commissioner of the Board of Control. Miss Darwin, who is a daughter of the late Sir Horace Darwin, was an honorary commissioner in 1920-30 and has been a commissioner since Jan 1, 1931. She is a member of the committee recently appointed to consider certain issues arising in connexion with the sterilisation of the mentally unfit.

THE twenty-fifth Conference of the Society for Experimental Biology will be held at the laboratory of the Marine Biological Association, Citadel Hill, Plymouth, on July 9-11. Some thirty papers are to be read, and on July 10 a visit will be paid to the laboratories and farms at Dartington Hall, Totnes.

THE fifty-first annual meeting of the Society of Chemical Industry will be held at Nottingham on July 12-15. The presidential address will be delivered on July 13 by Prof G T Morgan, on "Ourselves and Kindred Societies." On the following day, the Messel Medal will be presented to Sir William Pope, who will give an address on "Forty Years of Stereochemistry." The greater part of the meeting

will be devoted to visits to works in the neighbourhood.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.—An assistant lecturer in philosophy in the University of Manchester—The Registrar, University of Manchester (June 27). A reader in electrical engineering (telegraphy and telephony) at the Imperial College, City and Guilds College—The Academic Registrar, University of London, South Kensington, S W 7 (July 1). An assistant in the Department of Agricultural Botany of the Edinburgh and East of Scotland College of Agriculture—The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh (July 1). A full-time master for zoology and botany at the Medway Technical College, Gillingham—Head of the Senior Departments, Medway Technical College, Gillingham, Kent (July 1). An assistant lecturer in pharmaceuticals at the Cardiff Technical College—The Director of Education, City Hall, Cardiff (July 2). An assistant lecturer in geology in the University of Manchester—The Registrar, University, Manchester (July 2). A William Morris Research Fellow in Radiology at Mount Vernon Hospital—The Secretary of the British Empire Cancer Campaign, 12 Grosvenor Crescent, S W 1 (July 2). A part-time lecturer in the Biology Department of the Plymouth and Devonport Technical College—The Secretary for Education, Education Office, Rowe Street, Plymouth (July 5). An Alfred Fripp Memorial Fellow in Child Psychology at Guy's Hospital—The Dean, Guy's Hospital Medical School, S E 1 (July 8). A professor of electrical engineering at the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (July 9). A lecturer in physics and mathematics at the Sir John Cass Technical Institute—The Principal, Sir John Cass Technical Institute, Jewry Street, E C 3 (July 9). A head of the Chemistry Department of the Sunderland Technical College—The Principal, Technical College, Sunderland (July 11). A lecturer in zoology at the Victoria University College, Wellington, New Zealand—The Secretary, Universities Bureau of the British Empire, 88A Gower Street, W C 1 (July 12). Chemists in the Department of the Government Chemist—The Government Chemist, Clement's Inn Passage, W C 2 (July 16). A senior lecturer in economics and politics at the Rhodes University College, Grahamstown—The Secretary, Office of the High Commissioner for the Union of South Africa, 73 Strand, W C 2 (July 30). Evening instructors in advanced building construction, sanitary engineering, and physics, at the Kingston-upon-Thames Technical College—The Principal, Technical College, Kingston-upon-Thames. An assistant master for mathematics at the Halifax Municipal Technical College—The Principal, Municipal Technical College, Halifax. A lecturer in physiology at the Chelsea Polytechnic—The Principal, Chelsea Polytechnic, Manresa Road, S W 3. A whole-time lecturer in biology in the Department of Anatomy of the University of Durham College of Medicine—The Registrar, University of Durham College of Medicine, Newcastle-upon-Tyne.



## Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

## Theory of Induced Polarities in Benzene

RECENTLY in this periodical, Lapworth and Robinson<sup>1</sup> gave a criticism of the theory developed by Erich Huckel<sup>2</sup> of the induced polarities in benzene. This criticism referred mainly to three points, which may be shortly reviewed here (For the details see the note of Lapworth and Robinson.) First, the authors claim that any theory of the influence of groups on the course taken by substitution in benzene must be able to correlate this influence with the influence of the groups on the additive reactions of unsaturated compounds, since these reactions are said to obey the same laws as those that govern aromatic substitution, although in the case of substitution a hydrogen atom\* is expelled, which does not occur in the case of addition. Secondly, they correlate the influence of the different groups on the strength of binding of the H-atoms in benzene with the influence of such groups on the relative strengths of acids and bases. From this correlation they derive certain contradictions. Thirdly, they direct attention to the fact that in certain cases of substitution the loss of the hydrogen atom may happen at some other carbon atom than that which is to be the point of attachment of the new substituent.

With respect to this criticism we would like to make the following comments. In the theory of Huckel any more detailed picture for the mechanism (if the expression 'mechanism' is permissible for a quantum-mechanical process) of substitution reactions was intentionally avoided, since we believe that at present such a picture is not possible without quite arbitrary assumptions. We do not see how the assumption of Lapworth and Robinson that substitution in aromatic compounds is to be considered as an addition followed by the expulsion of the hydrogen atom could be proved either by experimental knowledge or by theoretical considerations. On the contrary, the assumption in Huckel's theory is *not* that the mechanism of substitution is to be considered as an expulsion of the hydrogen atom followed by the addition of the new substituent, but only that for a definite reaction the heat of activation is smaller for a hydrogen atom bound more loosely and greater for a hydrogen atom bound more strongly. It cannot be denied that for all simple substitution reactions which have been investigated *quantitatively* up to the present time this assumption—taking the charge density calculated by Huckel—leads to results which are in agreement with observation, and that not only the differences for the heat of activation of *o*-, *m*-, *p*-substitution can be explained, but also the order of these differences for Cl, Br, I as directing substituents can be predicted by the theory.

In connexion with this, point (3) of the criticism of Lapworth and Robinson may be discussed first. It is obviously quite possible—and according to chemical experience even probable—that in certain cases of substitution reactions, such as the perhalogenation of phenols<sup>3</sup> mentioned by Lapworth

and Robinson, the mechanism of reaction is quite different from that which underlies the substitution reactions discussed in Huckel's paper. But evidently one cannot expect that the theory will be applicable to this quite different type of reaction.

As to points (1) and (2) of Lapworth and Robinson, the criticism fails for similar reasons. The dissociation of an acid or base, point (2), is a process quite different from a substitution reaction, for the reason that in the first case a proton (or an OH<sup>-</sup> group) is freed from the molecule, whereas in the second case a hydrogen atom is freed, and in the first case the rest of the molecule remains as an ion and not as a neutral molecule as it is in the case of substitution reactions. It is clear that not only the influence of the group on the undissociated molecule is of importance for the dissociation, but also on the remaining ion. The latter has nothing to do with the charge density calculated by Huckel. Furthermore, in the case of dissociation, the H<sup>+</sup> or OH<sup>-</sup> is not attached directly to a C-atom in the benzene ring. We cannot see what connexion there is between the dissociation of acids and bases and substitution reactions in benzene. We do not feel it surprising, therefore, that the influence of the different groups on the dissociation is of an entirely different character from the influence on substitution reactions. (As examples may be mentioned  $\alpha$ -,  $\beta$ -,  $\gamma$ -chlorobutyric acid and *o*-, *m*-, *p*-chloro- and nitro-benzoic acids. The chloro- and the nitro-group have here an effect in the *same* sense, namely, strengthening, and at the same time not alternating.) Furthermore, the influence referred to, of groups on dissociation, has been observed in the case of *saturated* compounds also, whereas the directing influence for substitution and addition reactions is characteristic for aromatic and unsaturated compounds.

As to the addition reactions, point (1), nothing is known about the connexion of their mechanism with that of substitution reactions in aromatic compounds. Moreover, there are quite different kinds of addition reactions (for example, addition of alkali, halogens, halogen acid). Therefore also in this case one cannot expect that an explanation which has proved useful for simple substitution reactions will be applicable also to addition reactions—and conversely. It may be possible, however, also in the case of certain addition reactions to explain the influence of substituents on the places of addition by the calculation of the distortion of the charge density produced by the substituent, and it may well be possible that in this case (the addition of halogens, for example) the addition takes place more easily at places of higher electronic density—in contradiction to the case of substitution reactions, where, according to Huckel, the substitution happens more easily at places of lower electronic density, since the mechanism of reaction in the two cases may be quite different. But assumptions like this can be proved only by the quantum-theoretical calculation of the distortion of charge density for compounds for which the addition reactions have been investigated quantitatively, as is the case for substitution reactions discussed in Huckel's paper.

Summarising, we suggest that Lapworth and Robinson are trying to apply the theory of Huckel to cases which are in no simple way connected with the cases for which the theory of Huckel has been developed, and for which alone the theory claims to be applicable. What Lapworth and Robinson attempt, namely, to correlate the influence of groups on entirely different kinds of reactions, could be successful only if a complete theory for the mechanism of reaction for all these cases had been worked out. To give such a complete theory was not the intention

\* For the case of substitution Lapworth and Robinson repeatedly refer to the strength of binding and the expulsion of a *proton*, although as distinct from the case of dissociation of acids we have to deal here not with the proton but with the hydrogen atom. This mistake may perhaps be due to a misprint on page 326 in Huckel's paper, where (last but one line) "H-atom" should be read instead of "H<sup>+</sup>". From the whole discussion, however, it is clear that "H-atom" is to be read

of Huckel's paper. Its purpose was rather merely to show that for the influence of different groups on simple substitution reactions in benzene a simple and intuitive interpretation without detailed assumptions about the mechanism of reaction can be given by means of the quantum theoretical calculation of the distortion of the electronic distribution in the benzene ring produced by the substituent.

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<sup>1</sup> NATURE, 129, 278, 1932

<sup>2</sup> Z. Physik, 72, 310, 1931

<sup>3</sup> See, for example, Fries und Schimmelschmidt, *Ann. d. Chem.*, 484, 245, 1930

### Sulphur Assimilation in Wool Growth

In a series of important papers dealing with 'Bush sickness' of ruminants in New Zealand, T. Rigg<sup>1</sup> and his co-workers at the Cawthron Institute, following on the work of B. C. Aston,<sup>2</sup> established the incidence of this ailment as due to iron deficiency in well-marked localities recognised as 'unhealthy'. So far as the pasturage on healthy and unhealthy areas is concerned, the average seasonal iron content is practically the same. The soil-iron content, however, is in general far greater in the healthy areas, and in the one comparative case where the total iron is actually higher in the unhealthy area, the 5 per cent oxalic acid soluble iron (a rough measure of relative availability) is only one-fourth of that in the healthy area.

From these investigations emerges the startling but apparently unassailable conclusion that ingested soil is an absolutely essential supplement to the pasturage, which in itself, in clean condition, is definitely iron-deficient in all these sheep-rearing areas. The habit of the sheep of ingesting soil has thus provided Rigg with an interesting interpretation of the incidence of the similar 'pinning' sickness of Cheviots, which was unknown when the land was overrun with moles, but made its appearance when the moles were exterminated.

These investigations are also highly significant in relation to the associated nutritional problem of the excessive cystine yield in wool growth compared with the cystine available in normal diet.

To quote Rigg's own words, "an interesting and unexpected result was the great improvement both in growth and in lustre and elasticity of the new wool grown after administration of ferric ammonium citrate. It seems possible, therefore, that 'iron' plays some special rôle in wool growth. Is it possible that the wonderful results in increased wool growth obtained through the provision of a 'lick' of blood meal in the Meteor Downs experiment in Queensland may be due partly to the iron content of the blood meal (approximately 0.2 per cent)? It does not seem probable that the great increase in wool growth (averaging 20 oz. per sheep) was wholly due to the small amount of cystine administered in this way."

Accepting Evans's values<sup>3</sup> for the cystine contents of pastures, it is self-evident that conversion of non-cystine sulphur into cystine must occur, and one means of such conversion may be dependent upon invigorated action of intestinal bacteria, as recently suggested by Dr. Rimington and Mr. Bekker.<sup>4</sup>

Equally evident is the probability that adventitious sulphur as well as adventitious iron may be an essential supplement to the food-stuff. Soil ingestion in the areas investigated by Rigg, which are of volcanic

origin and almost exclusively silicious in character, would not appreciably affect the sulphur intake, yet with the iron supplement not only do the general anæmic symptoms of bush sickness disappear, but, also, the wool, which practically ceases to grow in severe cases, resumes normal growth and lustre, with a well-defined 'break' coincident with the remedial treatment. Pasturage from such soils may well prove to be deficient even in total sulphur (though evidence on this point is lacking). In this event, the stock-water supply, particularly from artesian wells, may assume a special significance.

Evident again is the sweeping conclusion that the view hitherto widely accepted, which regarded the cystine supply as the essential limiting factor in wool production, is now definitely exploded, and that the various attempts to influence wool growth directly by administering cystine-rich fodder were foredoomed to failure.

The situation has thus radically changed since 1927, when I first pointed out the significance of the variable sulphur content of wool in its histological, nutritional, and technical aspects.<sup>5</sup> The extensive scheme of research developed from this, in conjunction with my present and past colleagues and co-workers, Mr. Barritt,<sup>6</sup> Dr. Rimington,<sup>7</sup> and Mr. Bekker,<sup>8</sup> did in fact include an attempt to influence the sulphur content of rabbit wool by addition of varied doses of cystine and of wool hydrolysate, to a standard ration.<sup>9</sup> It was clear from these experiments that the seasonal factor completely masked any possible cystine effect, a difference of as much as 18 per cent in the sulphur content of wool from the same animal between one three months' clip and the next being found equally in the cystine-fed and control animals.

It was, moreover, further observed by Mr. Barritt and Dr. Rimington<sup>7</sup> that the increased sulphur yield was still wholly in the form of cystine.

While the recent developments do not lessen but rather emphasise the importance of the work on sulphur content in relation to wool quality, initiated in these laboratories, they expose the dubiety of attempts to associate with a supposedly specific diet supplement, divergent effects from those obtained with a basal diet control. In view of the above-mentioned and possibly other as yet unrecognised factors, field-work data especially would appear to need very careful consideration before recommendations are made to pastoralists on nutritional methods of improving wool growth and quality.

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<sup>1</sup> Rigg and others, N.Z. Dept. of Scientific and Industrial Research, *Bulletin*, No. 32, 1932.

<sup>2</sup> Aston, *Trans. N.Z. Inst.*, 58, 536, 1928, and later papers.

<sup>3</sup> Evans, *J. Agric. Science*, 21, 806, 1931.

<sup>4</sup> Rimington and Bekker, *Nature*, 129, 687, May 7, 1932.

<sup>5</sup> King, *J. Text. Inst.*, 18, 364T, 1927. *Text. Merc.*, Oct. 23, 17, 1929.

<sup>6</sup> Barritt and King, *J. Text. Inst.*, 17, 386T, 1926. 20, 151T, 1929. *Brochem. J.*, 25, 1075, 1931.

<sup>7</sup> Barritt and Rimington, *Brochem. J.*, 25, 1072, 1931.

<sup>8</sup> Bekker and King, *Brochem. J.*, 25, 1077, 1931.

<sup>9</sup> Barritt, King, and Pickard, *Brochem. J.*, 24, 1061, 1930.

### Constitution of the Keratin Molecule

OF the two comments which Dr. Rimington<sup>1</sup> has to make on our recent note<sup>2</sup> regarding the constitution of the keratin molecule, one is erroneous and the other misleading. In our original communication, we claim to have shown that the amount of free amino

nitrogen in wool is precisely equivalent to the amount of hydrochloric acid absorbed from solution at pH 1.0 and to the arginine and lysine content of the fibre as determined by Marston.<sup>3</sup> In Rimington's opinion, the significance of these identities is lost because "the guanidine group of arginine does not yield nitrogen with nitrous acid under the usual conditions." Van Slyke and Birchard<sup>4</sup> are quoted in support of the contention, a more recent paper by Plimmer<sup>5</sup> being overlooked. The latter has shown that the guanidine group of arginine is attacked slowly by nitrous acid under the usual conditions, and his data indicate that, in twenty-four hours, reaction with the second amino group is almost complete. The determinations which we made of the free amino nitrogen in wool were all allowed to proceed for twenty-four hours, and there is, in consequence, no necessity to follow Rimington in his speculation "that wool probably contains hydroxylysine or other diamino acid in addition to lysine." The "other diamino acid" is undoubtedly arginine.

In regard to the disagreement between Marston's<sup>3</sup> and Vickery and Block's<sup>6</sup> determinations of the arginine and lysine content of wool, reference must be made to the preceding paper<sup>7</sup> by Vickery, which contains an illuminating comment on the methods employed. He states that "there is, therefore, every reason to believe that the arginine content of human hair may be well over 8.0 per cent", the value he obtained. Similarly, the value of 7.8 per cent for the arginine content of wool is probably low, as also Rimington's own value, obtained, presumably, by the same technique. There is therefore every reason for adopting the higher value of 10.2 per cent, obtained by Marston, as being the true arginine content of wool.

Rimington's second difficulty is that no account was taken in our original communication of the amide nitrogen in wool, which amounts to 1.2 per cent by weight. Even if the amounts of arginine and lysine present in wool are assumed to be the maximum values obtained by Marston, an excess of glutamic and aspartic acids remains unaccounted for after the necessary amounts for combination with arginine and lysine have been deducted from the quantities estimated by Abderhalden<sup>8</sup> in wool. This excess would be available for combination with 0.4 per cent of amide nitrogen. But Abderhalden's determinations of the glutamic and aspartic acid content of wool are known to be low, and since only 7.5 per cent of the wool fibre has so far been accounted for by protein analysis, there can be little doubt that sufficient glutamic and aspartic acids will be found present in wool to account quantitatively for its content of amide nitrogen, as well as for that needed to combine with arginine and lysine. We had proposed to avoid all comment on amide nitrogen until such a relationship had been established, and determinations of the glutamic and aspartic acid content of wool are in progress in this laboratory.

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<sup>1</sup> Rimington, *NATURE*, 129, 580, April 16, 1932.

<sup>2</sup> Speakman, *NATURE*, 128, 1073, Dec 26, 1931.

<sup>3</sup> Marston, Council of Sci and Ind Research, Commonwealth of Australia, *Bull* 38, 1928.

<sup>4</sup> Van Slyke and Birchard, *J Biol Chem*, 16, 539, 1913-14.

<sup>5</sup> Plimmer, *Biochem J*, 18, 105, 1924.

<sup>6</sup> Vickery and Block, *J Biol Chem*, 86, 107, 1930.

<sup>7</sup> Vickery and Leavenworth, *J Biol Chem*, 83, 523, 1929.

<sup>8</sup> Abderhalden and Voitnovici, *Z physiol Chem*, 52, 368, 1907.

### Adsorption of Weak Electrolytes on Charcoal

WE wish to direct attention to two recent statements about our experiments, which may be misleading if left without comment.

In a paper describing results of wide biological significance, Ockrent<sup>1</sup> has suggested, as an interpretation of our results, that in accordance with his theory of selective adsorption "it is to be expected that in a mixture containing strongly adsorbable undissociated molecules and weakly adsorbable ions (arising either from the presence of salt or by the slight dissociation of acid or base) the more strongly adsorbable component will be preferentially adsorbed." It would seem, however, that if ionic adsorption were normally suppressed by simultaneous molecular adsorption, some degree of adsorption should be observed in solutions of such hydrogen ion concentration that the amount of adsorbate existing in the molecular form is negligible. Ockrent observes a very slight hydrolytic adsorption of sodium salicylate under his conditions (using activated sugar charcoal). On the other hand, with the vacuum-heated charcoals used in our experiments, there was no measurable hydrolytic adsorption of propionate, succinate, or hexoate. Hence, we do not think Ockrent's interpretation correct.

The same criticism applies to the statements of Roychoudry and Mukerjee.<sup>2</sup> In an interesting communication, the latter have established that strong anions and cations are adsorbed by activated charcoals of high purity (cf. Miller<sup>3</sup>). These authors further suggest that these observations are not consistent with our views on adsorption. This surely is due to a misunderstanding. Throughout our work, attention has been confined to a study of the adsorption of weak electrolytes by purified, vacuum-heated charcoals. Such a carbon being degassed, and having very little mineral impurity, should approximate very nearly to a true neutral surface. The results which we obtained indicate clearly that weak organic electrolytes are adsorbed only in the molecular form.<sup>4, 5, 6</sup>

From the above experiments, taken with the earlier work of Miller, we must conclude that the adsorption of weak electrolytes by highly purified charcoals is essentially a different process from the adsorption of strong electrolytes under the same conditions.

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<sup>1</sup> Ockrent, *J Chem Soc*, 613, 1932.

<sup>2</sup> Roychoudry and Mukerjee, *Kolloid Z*, 57, 302, 1931.

<sup>3</sup> Miller, "Colloid Symp Monograph", No 5, p 55, 1927.

<sup>4</sup> Phelps and Peters, *Proc Roy Soc A*, 124, 584, 1929.

<sup>5</sup> Phelps, *J Chem Soc*, 1724, 1929.

<sup>6</sup> Phelps, *Proc Roy Soc A*, 133, 155, 1931.

### Mechanical Hardness Influenced by Magnetisation

In a paper on "A Correlation between the Mechanical Hardness and the Magnetostrictive Effects of Ferromagnetic Substances",<sup>1</sup> attention was directed to the possibility of annealing or softening a steel rod by 'working it' magnetically.

Recently the work of E. G. Herbert,<sup>2</sup> in which he deals with the hardening of metals by rotating magnetic fields, has been brought to my notice. Herbert says, "The result of the magnetic treatment was an immediate decrease of hardness followed by an increase, stability being attained after 3 hours." The work in 1923 seems to be confirmed by Herbert's work.

A series of four rods were given different degrees

of mechanical hardness by different drawing temperatures. The changes in total length were then measured as the applied magnetising force was increased from zero up to about 950 gauss. The changes in total length for the four rods are shown in Fig. 1. The rods were all of the same length, namely,

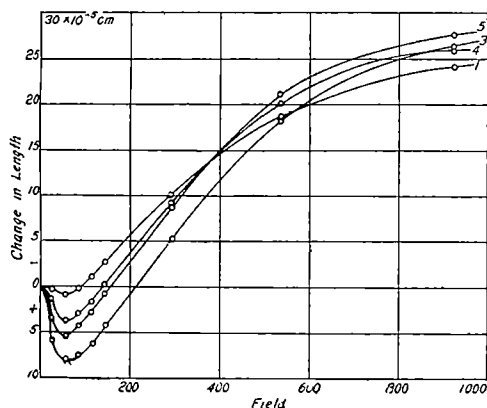


FIG. 1

58.5 cm. All four rods increased their lengths for small field strengths, but decreased them for strong. The values of the maximum elongations increase with decrease in scleroscope hardness.

| Rod No. | Scleroscope Hardness | Max. Elongation          |
|---------|----------------------|--------------------------|
| 1       | 70.7                 | $1 \times 10^{-5}$ cm.   |
| 4       | 51.9                 | $3.7 \times 10^{-5}$ cm. |
| 5       | 42.8                 | $5.3 \times 10^{-5}$ cm. |
| 3       | 34.6                 | $8.1 \times 10^{-5}$ cm. |

Each one of the curves in Fig. 1 is the average of 4-6 sets of curves. The steel rod was demagnetised by sending a decreasing  $AC$  through the coil surrounding it. Then the rod was magnetised by a  $DC$ , so that the field was directed upwards in a vertical coil and increased continuously from zero up to a value of about 950 gauss. The deflexions of the extensometer were recorded photographically. This took about 60 seconds for each run. Again the rod was demagnetised, but this time the rod was magnetised by a  $DC$  with the field directed downward instead of upward as in the preceding run. This procedure was repeated 4-6 times, each time a reversal of the  $DC$  field occurred.

Rod No. 5 showed a certain instability, and it was only after repeated reversals of the  $DC$  field, with demagnetisation between runs, that it seemed to settle down. A further study of the preliminary runs on this rod showed that each time the rod was demagnetised, and the field was reversed, the maximum elongation was increased, so that a series of curves was obtained for rod No. 5, not unlike the series of curves shown for the four rods in Fig. 1. If, then, increase of the maximum elongation may be interpreted as an increase in the softening of the rod, and Fig. 1 indicates this, then rod No. 5 showed a softening due to magnetic working. Apparently the work in 1923 caught only the softening which occurs at the time of magnetic treatment, and did not disclose, what Herbert has recently shown, that the magnetic treatment is followed after some time by an increased hardness and stabilisation.

The work of Herbert seems to be a most important contribution to the theory of hardness. It is hoped that the magnetostrictive tests may be carried on much more extensively than has been done, for, in my opinion, the magnetostrictive tests offer one of the

outstanding approaches to the study of the mechanical properties of ferromagnetic materials.

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<sup>1</sup> *Trans. Amer. Soc. Steel Treating*, 362, April 1924.

<sup>2</sup> *Proc. Roy. Soc.*, 130, 576, 1930-31. *American Machinist*, 74, 967, June 25, 1931.

### Neanderthal and Modern Man

THE recent communication by Miss Garrod<sup>1</sup> concerning discoveries of human remains in Palestine raises questions of such wide and general interest, and bears so directly on work in which we have been engaged, that we venture to put forward the following views as to a possible line along which a synthesis may be made of the complicated evidence so far obtained relating to the fossil history of the human family.

Miss Garrod reports the discovery by Mr. MacCown in a Mousterian deposit of the skeleton of a young child, the skull of which had certain features which suggested the Neanderthal race, while "others seemed to be incompatible with it." We are not told what these were, but in the *Times* of May 4, Sir Arthur Keith is reported as saying that while "the front of the skull was Neanderthal, the back of the head was of an entirely new type, more resembling that of modern man", so that the specimen might be regarded as a transitional stage between European Neanderthal and modern man. It is clear that this young form differs considerably from the adult more recently discovered, which, whether it represents a new species or a new genus, is of the neanderthaloid type.

Concerning the difference between the young and adult forms of the skull of *Homo neanderthalensis*, however, we are in the fortunate position of being able to make some definite statements, thanks to the number, now considerable, of adult specimens of the species that are known, and to the Devil's Tower skull discovered by Miss Garrod at Gibraltar, which represents a stage of development of an individual of the Neanderthal race corresponding to a modern human infant of between five and a half and six years of age. Although this Devil's Tower skull is quite clearly Neanderthal, in general form it bears a closer resemblance to modern adult *Homo sapiens* than it does to its own adult (*H. neanderthalensis*) or to the young form of modern *H. sapiens*.

The resemblance between adult *H. sapiens* and young *H. neanderthalensis* suggests that the former may have been descended from the latter by a progressive retention into adult life of characters present in the young stages in the ancestor. This view is but an application of that which was most skillfully developed by Bolk<sup>2</sup> in his demonstration of the changes accompanying the descent of man from other mammals—a view favourably commented upon by Sir Arthur Keith<sup>3</sup> and recently shown to be capable of wide application in the realm of organic evolution,<sup>4</sup> and especially concerned in the production of new generalised types, such as the Insecta or Vertebrata, the generalised character of the original representatives of which may be estimated by the large amount of variation and radiation which the members of these groups have since undergone. Evolution by such means may be referred to as 'fœtalisation', or, more generally, 'pædomorphosis'. The differences between adult *H. neanderthalensis* and adult *H. sapiens* skulls in respect of the dentition, chin, the position of the foramen magnum, and the nature of the frontal eminences, to mention only a few points, are precisely

what would be expected if, in its ontogenetic development, *H sapiens* departed less from its embryonic form than *H neanderthalensis*. In other words, *H sapiens* is simpler or more generalised, and this attribute of his evolution accords well with what has been said above with regard to pedomorphosis. At the same time, of course, *H sapiens* has also evolved along his own progressive lines.

We therefore suggest that the available evidence may be most profitably synthesised by regarding *H neanderthalensis* as the antecedent in consanguinity of *H sapiens*, the descent of the latter having been characterised by pedomorphosis, so that it may be said that *H sapiens* has derived his main characters from young *H neanderthalensis*, the adult characters of *H neanderthalensis* having been discarded and lost by this process. It is interesting to us to note that this view is in substantial agreement with the conclusions with regard to the affinities between *H neanderthalensis* and *H sapiens* at which Prof Hrdlička has arrived from other lines of investigation.<sup>5</sup>

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G. R. DE BEER

University Museum, Oxford,  
June 15

<sup>1</sup> Garrod, D., *Times*, June 11, 1932.  
<sup>2</sup> Bolk, L., *Lancet*, Sept. 10, 1921, *Proc Konink Akad v Wetensch te Amsterdam*, 25, 1922, "Das Problem der Menschwerdung", Jena, 1926.

<sup>3</sup> Keith, A., *NATURE*, Supplement, Aug. 18, 1923.

<sup>4</sup> de Beer, G. R., "Embryology and Evolution", Oxford, 1930.

<sup>5</sup> Hrdlička, A., *J. Roy Anthropol Inst.*, 57, 1927.

#### Mother-of-Pearl Clouds over Scandinavia in January and February 1932

THE remarkable stratosphere clouds<sup>1</sup> which the late Prof Mohn called mother-of-pearl clouds, again appeared over Scandinavia several times during the months of January and February of this year. Elaborate preparations had been made to obtain photographs and visual observations of these remarkable clouds. All my aurora stations in southern Norway were ready to take photographs as soon as the clouds appeared, and Capt Ween, of the Norwegian Geodetic Survey, in collaboration with me, had made preparations to take photographs with modern photo-theodolites. Further, through the photographic stores of Nerlien in Oslo, I had secured assistance in obtaining photographs and moving pictures of the clouds in natural colours. Through broadcasting and by articles in the Press, I asked people to send me observations of the clouds, and this proved to be a most valuable help, since I received about three hundred most interesting reports from different parts of Scandinavia and Finland.

The clouds were first seen in Oslo on Jan. 14, and during the following week from several parts of northern Norway. On Jan. 27 and 29 they were again seen in Oslo, and about fifty successful photographs for determining the height were secured at my aurora stations in southern Norway. Some photographs were also taken by Capt Ween. During the following two weeks the clouds were observed on several occasions from southern, central, and northern Norway.

On Feb. 19, clouds of exceptional beauty were seen about sunset in southern Norway, about seventy reports, with sketches, and a series of interesting photographs, were received. In Oslo, I observed the clouds for three hours from sunset and from about midnight until the next morning, the clouds being illuminated by the moon. All my aurora stations were in action, and more than a hundred successful photographs, with base lines 27.3-105 km., were taken, first after sunset and then during the night in moonshine.

A series of successful photographs was also taken by Capt Ween, and four very interesting photographs and a moving picture, both in natural colours, were secured by Mr Simonsen and Mr Gibbons, of the firm of Nerlien, Oslo.

The preparation of the large amount of material will undoubtedly reveal much that is new concerning these remarkable clouds. Preliminary measurements of some of the photographs show the same altitudes as before, that is, somewhere between twenty and thirty kilometres.

During the night of Feb. 19-20, I made an interesting observation which may give some idea as to the nature of these clouds. A rather homogeneous cloud happened to be near the moon, and I then observed part of a large corona. From the moon and outwards there was a region of bluish-yellow colour, and then came part of a red ring with an inner radius of between fourteen and fifteen degrees from the moon. The outer radius was not observed. If we assume the outer radius of the red ring to be equal to or greater than 18°, we have<sup>2</sup> for the cloud particles diameters not exceeding 0.0025 mm., the height of the clouds was at that time 21-25 km., according to preliminary measurements.

Oslo

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<sup>1</sup> "Clouds High in the Stratosphere" By Prof S. Chapman, *NATURE*, April 2, p. 497.

<sup>2</sup> Penner-Evner, "Meteorologische Optik", Zweite Auflage, 2. Kapitel, Wien und Leipzig, 1922.

#### Freshwater and Land Mollusca from British Somaliland

SINCE my letter on climatic changes in British Somaliland was written,<sup>1</sup> Major Connolly has kindly identified for me some freshwater and land mollusca from that Protectorate, collected in the Dumuk tug near Buramo, a few miles from the Abyssinian frontier.

They were extracted from the bank of the dry channel under about fifteen feet of alluvium, and include *Zebrinops revorli* (?) Bgt. and two species of *Subulina*, known from Gallaland, but not before recorded from British Somaliland, namely, *S. erlangeri* Bttgr. and *lacuum* Bttgr.

*Z. revorli* is more or less a desert form. Although these three terrestrial species were found at nearly the same horizon as the freshwater forms and may have fallen or been swept by flood waters into the tug, yet their occurrence at least suggests a pause in deposition when the expanse of alluvium through which the present channel is cut became dry land.

The point is worth investigation, as such a break, if confirmed, may simplify the correlation of variations of climates with other areas.

The remaining species are (1) the widely distributed *Melanoides tuberculata* Mull., and (2) *Planorbis stanleyi* Smith, not previously recorded from British Somaliland, although a living Abyssinian form.

In addition to these five species, *Z. maunorianus* Bgt. was found on the Sorl Haud between Illad and Heman (lat. 48° N and long. E 10°). The distribution of this snail, amongst other details, is given by Connolly in a paper published in 1931.<sup>2</sup>

From the ruins of Gorgab, he identifies *Cerastus somaliensis* Smith, and another species of that genus, unidentifiable by reason of the fragmentary condition of the specimen, also *Sub. erlangeri* Bttgr. and *Limicolaria donaldsoni* Pilsb.

Two small pieces of the shells of freshwater mussels were picked up amongst the ruins of the old town of Elk, forty miles south of Buramo and about thirty from the Abyssinian frontier. These are determined to be (1) a species of *Mutela*, and (2) most probably a

*Umbo* Below Eik is a shallow depression which was once clearly a small lake and is even now swampy during the rainy season. Fragments of glass bangles from the ruins were kindly determined by Mr R. L. Hobson of the British Museum to be of Arab manufacture of the fifteenth century or later. The obvious inference is that desiccation has proceeded rapidly during the last 500 years, although at present the doubt must remain whether the shells were brought from elsewhere for domestic purposes. No mussel shells, however, were found in four other similar ruins examined, a point in favour of their former habitat being Eik.

It may be added that no doubt can exist that a survey dealing with the Pleistocene geology of Somaliland, and including the Northern Frontier Province of Kenya, would provide results of no small scientific interest, especially if archaeological work were undertaken at the same time.

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<sup>1</sup> NATURE, 129, 651, April 30, 1932

<sup>2</sup> Ann Mag Nat Hist, Ser 10, 8, p 322

### Specific Heat of Gases at High Temperatures

EVIDENCE has been accumulating in my laboratory that combustion is in general far from being complete at the moment of maximum pressure in closed vessel gaseous explosions even under the best experimental conditions, and that consequently specific heat values for gases at high temperatures determined by the explosion method are much larger than the true values. Much of this evidence has rested upon certain assumptions, such, for example, as that the specific heats of various diatomic gases constituting the diluents in explosive mixtures are practically the same over any given temperature range.<sup>1</sup> But recently Messrs J. R. Brown and A. H. El Din have completed a carefully conducted and extended series of experiments which seem to offer conclusive proof that incomplete combustion at the moment of attainment of maximum pressure in closed vessel explosions is generally so large as to make the explosion method as usually employed unreliable for specific heat determinations.

In these experiments, mixtures of identical composition were exploded in two spherical vessels of different sizes—one 6 inches in diameter and the other 18 inches. Both pressures and heat losses during the explosion period were measured in each vessel. It was found that higher pressures were developed in the larger vessel than in the smaller vessel, and that these higher pressures were not to be explained to any very considerable extent in terms of smaller relative heat losses in the large vessel. The conclusion seems irresistible that combustion is more complete in the larger vessel than in the smaller one, due possibly—at any rate, in part—to the fact that as the time of explosion is greater in the larger vessel, combustion is in a more advanced phase.

Taking the data from one typical experiment in which the explosive mixture was an over-rich carbon monoxide air mixture at atmospheric density, it was found by the usual method of calculation that the apparent specific heat of carbon dioxide over the temperature range of the explosion, after allowing for the measured heat loss, was 15.55 for the small vessel (temperature range 20°–1920° C) and 14.4 for the larger vessel (20°–1990° C). The values for the specific heats of carbon dioxide over these temperature ranges, as given by Partington and Shilling, are 9.75 and 9.81 respectively, and these are in all proba-

bility nearer to the true values than those yielded by the explosions. The inference, then, is that while combustion is more complete in the large vessel than in the smaller one, it is seriously incomplete in both vessels.

Hydrogen explosions in the two vessels yielded apparent specific heats for steam which differ to much the same extent as those for carbon dioxide, but they are nearer to the Partington and Shilling values. An over-rich hydrogen mixture, for example, yielded apparent specific heat values of 10.7 for the smaller vessel (20°–1920° C) and 9.5 for the larger vessel (20°–1985° C). The values given by Partington and Shilling for these temperature ranges are 8.4 and 8.54.

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<sup>1</sup> Thorp, *Phil Mag*, Dec 1929, p 829

### Relative Excitation of the Three X-ray *L*-Levels with Cathode Rays of Different Velocities

SKINNER, Robinson, and others have studied the relative excitation of the three X-ray levels  $L_{III}$ ,  $L_{II}$ , and  $L_I$ , when for this excitation primary radiation of different wave-length is used. Such experiments may be done by studying the relative intensity of the emission lines which combine with each of the three *L*-levels (Skinner) or by an estimation of the relative intensity of the secondary  $\beta$ -rays which emerge from these levels (Robinson). The following remarkable result was obtained: when the exciting radiation is a little harder than that of the hardest *L*-absorption edge ( $L_I$ ), then the levels  $L_{III}$  and  $L_{II}$  give much more intense lines than the level  $L_I$ . With increasing frequency, however, this relation is totally changed in favour of  $L_I$ . With a frequency about five times as large as that of the *L*-edges,  $L_I$  is excited to a much larger extent than  $L_{II}$  and  $L_{III}$ , so that the generally not very intense lines belonging to  $L_I$  become the most intense lines of the corpuscular  $\beta$ -ray spectrum in the experiments such as done by Robinson. This result points to the large influence of the quantum number  $l$  (which is 1 for  $L_{III}$  and  $L_{II}$  and 0 for  $L_I$ ) on the excitation of the three *L*-sublevels.

It seemed to us worth while to try if a similar effect exists when the excitation is brought about by cathode rays of different velocities. The difficulty with such measurements is that the electrons which penetrate into the anticathode lose their velocity according to the Whiddington law, so that even when the X-ray tube is operated with direct current a whole spectrum of velocities is obtained in the anti-cathode. We have tried to avoid this difficulty in the same manner as has been done for other purposes by Webster. A massive anticathode of beryllium with an extremely thin layer of tungsten was used and the three *L*-levels of tungsten were studied. The thickness of the tungsten was such that not more than 5 per cent of the energy of the cathode rays was absorbed by it. In this case, apart from small corrections, the relative intensities of the X-ray lines coming from the three different *L*-levels give a good idea of the relative cathode ray excitation of these three *L*-levels. The lines  $\beta_2$  ( $L_{III}$ ),  $\beta_1$  ( $L_{II}$ ) and  $\beta_3$  ( $L_I$ ), which lie about in the same region of the spectrum, were used. When the tension varied from 15 to 40 kv, the line  $\beta_1$  gets about 10 per cent more intense relative to  $\beta_2$ , the line  $\beta_3$ , however, gets about 30 per cent more intense relative to  $\beta_2$ . This result is the more interesting because for tungsten the energy difference  $L_{II}-L_{III}$  is about 2.5 times as large as the difference  $L_I-L_{II}$ . It seems, therefore, that here, as in the case of the excita-



tion by primary radiation, the influence of the quantum number  $l$  is of more importance than the energy differences between the three  $L$ -levels

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#### Photochemistry of Vitamins A, B, C, D

PROBABLY because our letter in NATURE of May 14, p 720, on this subject was too compressed, some misunderstanding seems to have arisen as to the method which we have described. After reading the remarks of Prof Heilbron and Dr Morton in NATURE of June 11, p 866, we think it may save further difficulties if we reaffirm the purpose of our original communication. We wished to show the possibility and to describe some applications of selective *monochromatic irradiation* as an instrument of research in biological problems.

Before this, filters have been used in order to separate different spectral regions, chiefly because monochromators have not been constructed to give a sufficiently high intensity in the ultra-violet to bring about photochemical changes in a reasonable time. (In 1929 Marshall and Knudson, however, applied monochromatic radiation to ergosterol.) With our instrument, we are able to secure accurately monochromatic light of very high intensity. The use of broad bands of ultra-violet radiation, even though selected with a knowledge of absorption spectra, may often conceal the essential molecular changes which occur in a photochemical reaction. Thus, unless the parent substance is irradiated with strictly monochromatic light, the possibilities are left open (a) that the parent molecule may be destroyed in two or more ways simultaneously, and/or (b) that the daughter molecule may be destroyed by absorption of wavelengths other than that causing its production from the parent. These possibilities cannot be definitely excluded by the use of filters, but only by the use of monochromatic radiation.

The method and its applications (which naturally vary from molecule to molecule) will be described in full in a subsequent publication. Until this complete statement is available, we feel that it will economise in time and space to postpone discussion of the detailed points raised by Heilbron and Morton. We should, however, like to say, in reference to vitamin A, that up to the present we have only recorded the fact that on irradiating carotene we have obtained a band near 3280 Å, at a later date, however, we hope to be able to announce the results of experiments on the nutritive value of samples in which the whole of the carotene has been destroyed. We are also trying to devise physical tests more detailed than those in present use, to apply to our irradiated product and to vitamin A itself.

F P BOWDEN  
C P SNOW

Laboratory of Physical Chemistry,  
Cambridge, June 10

#### Hexuronic Acid as the Antiscorbutic Factor

At the request of Prof A Szent-Gyorgyi, crystalline hexuronic acid from adrenal glands, kindly supplied by him, was tested by us for antiscorbutic activity. Six guinea-pigs, weighing 260 gm, 275 gm, 300 gm, 280 gm, 295 gm, and 310 gm, were employed in the test. Each animal received 1 mgm of the preparation daily, the first dose being administered when the animals had been six days on the scorbutic diet.

Fifty-five days after the commencement of the experiment the guinea-pigs were chloroformed, owing

to the exhaustion of the supply of hexuronic acid, and were found to be free from macroscopic signs of scurvy at autopsy. The weight of the animals at the time of death was 430 gm, 465 gm, 355 gm, 392 gm, 370 gm, and 442 gm respectively. All the guinea-pigs showed uninterrupted growth during approximately the first forty days, after which time their weights declined slightly. The post-mortem examination did not, however, suggest that this decline was due to scurvy.

The results are, therefore, very similar to those obtained by Svirebely and Szent-Gyorgyi,<sup>1</sup> but, as I pointed out later,<sup>2</sup> although this proves the presence of the antiscorbutic factor in Szent-Gyorgyi's preparation, it does not, in my opinion, afford sufficient evidence of the identity of hexuronic acid with the antiscorbutic factor.

S S ZILVA

Lister Institute of Preventive Medicine,  
London, S W 1, June 11

<sup>1</sup> NATURE, April 16, p 576

<sup>2</sup> NATURE, May 7, p 690

VITAMIN C is the name given to a substance the lack of which causes scurvy. Svirebely and Szent-Gyorgyi have shown (NATURE, April 16 and May 7) that the hexuronic acid which was discovered by one of them, and is present in orange and lemon juice, is capable of preventing scurvy. Furthermore, they have shown that lemon juice has approximately the same antiscorbutic activity as the hexuronic acid present in it. In my opinion, no clearer demonstration could have been given of the identity of hexuronic acid and the vitamin. No circumstantial evidence can have much value against such a direct demonstration. The only possibility of doubt was with regard to the correctness of the experiment. However carefully an experiment is done, there is always the chance of an error, especially in such a subtle question as a deficiency disease. For this reason I asked Dr S S Zilva to repeat our experiments, and supplied the necessary crystalline hexuronic acid. Dr Zilva was kind enough to accept and undertake the work. As he reports above, his experiments were entirely confirmatory, so that no doubt is left whatever regarding the antiscorbutic activity and thus the vitamin nature of the hexuronic acid.

It needs very big assumptions to explain these results in any way other than by supposing that hexuronic acid is in fact the vitamin. An adequate explanation will be given in our detailed report in the *Biochemical Journal* of the observations which led Dr Zilva several years ago to the opinion that the vitamin could not be part of the 'Reducing Factor', and thus could not be identical with hexuronic acid.

A SZENT-GYORGYI

Institute of Medical Chemistry,  
University Szeged, Hungary, June 17

#### Central and Peripheral Vision

It is generally stated that the fact, long known to astronomers, that faint stars are seen most distinctly when viewed eccentrically is a phenomenon of dark adaptation, but this is not the case, as exactly the same condition is found with the light-adapted eye, as a simple experiment will show.

If two discs of white paper, each of a diameter of a sixteenth of an inch, be pasted on black cardboard an inch apart and viewed from a distance of twelve to eighteen inches, it will be found that the one that is directly looked at (with one eye) appears much darker than the other. This is observed in broad daylight.

F W EDRIDGE-GREEN

Board of Trade, S W 1,  
June 4

## Research Items

**Ancient Eskimo Art**—Archæological investigations on St Lawrence Island in Northern Alaska, carried out by Mr Moreau B Chambers (Report on Investigations and Field Work of the Smithsonian Institution in 1931, *Pub* 3134), have brought to light evidence from a small village site which has an important bearing on the source and development of Eskimo glyptic art. The village was abandoned many centuries ago when a rich old arctic culture still existed along the coasts of Siberia and Alaska in the vicinity of Bering Strait. The inhabitants lived in small houses, partly underground, with floors of stone-slab and walls of driftwood. Their implements differed little from those of later times, but their art was unique, giving the old Bering Sea culture its distinctive stamp. Bone and walrus ivory were carved by stone tools in many and ingenious forms. Animal figures and human heads are good examples of carving in the round, but the inhabitants excelled in executing graceful curving and flowing lines incised on ivory surfaces. A little more than a thousand years ago the Bering Sea culture underwent a sudden change. Instead of graceful curvilinear designs they used deeper, straighter, and more evenly incised lines. This style, though graceful, was inferior to that which preceded it. It is known as "Punuk" from the island where it was first isolated in 1928. It would appear that the cause of the cultural change was the introduction of iron from Siberia, some hundreds of years before the arrival of the Russians there in the seventeenth century. Chinese records show that iron was being used in Siberia in the third century A.D.

**Buka and Bougainville**—Miss Beatrice Blackwood's preliminary report on her expedition to Buka and Bougainville, Solomon Islands, undertaken in 1929 on the invitation of the Institute of Human Relations, Yale University, has been published (*Oceania*, 2, No 2). The inhabitants of Buka were found to be more affected by contact with white civilisation than had been anticipated, but in Bougainville, especially in the central mountainous portion, they are still very hostile. The mountain people live in scattered settlements of one, two, or three huts at short distances from one another, the coastal and island people in villages varying in size from half a dozen huts to twenty or thirty. Some villages are composed of several hamlets. The huts are long and narrow, with low walls of betel-nut planks and an overhanging roof of sago-palm leaves, in shape somewhat like a flattened Gothic arch. They are arranged in straight lines. Each house is occupied by a family group, and every village has one or more boys' houses. In every village also there is one family of recognised high rank. Rank is hereditary in the female line. The successor to a chief is his eldest sister's eldest son. Marriage is normally exogamous; man and wife as a rule belong to different villages. Child betrothal is the rule. When a suitable girl child is found by a boy's father, he gives her father a present as a sign that she is appropriated. This is the beginning of a long series of reciprocal visits, culminating in a marriage ceremony, the essential part of which is that the couple sit down in close contact and are offered food and drink, which they must pretend to taste, the first meal eaten together being taken afterwards. Marriage is not consummated until after puberty.

**Swarming of the Palolo Worm in March**—In an account of the Polychæta collected during the voyage of Prince Leopold of Belgium to the Dutch East

Indies ("Rés Sci Voyage aux Indes Orientales Néerlandaises", vol 2, Fasc 7, 1931) Prof P Fauvel directs particular attention to a collection of Palolo worms made at Amboina in the Moluccas. This collection includes numerous fragments, up to 30 mm in length, of both sexes, of *Eunice viridis*, all lacking their anterior ends. This epitokous form, which consists of the posterior part of the body containing the reproductive products, detaches itself from the anterior non-sexual part, which remains ensconced in the fissures of the coral reefs. The posterior parts swarm at the surface of the sea, where they shed their sexual products. This swarming of the Palolo and its relation to the phases of the moon has been described by many writers. In the New Hebrides, at Samoa, Tonga, and Viti, swarming occurs in October-November, it is of considerable interest to find that in the bay of Amboina swarming occurred in March. The collection was made on March 28, 1929, the last day of the swarming, towards sunset, and the moon (then sixteen days old) was bright. Besides *Eunice viridis*, numerous portions of *E. dubia* were taken at the same time.

**East-Indian Alcyonarians**—Sir J Arthur Thomson and Miss Laura M I Dean have described a rich collection of alcyonarians from the *Siboga* Expedition to the Dutch East Indies ("The Alcyonacea of the *Siboga* Expedition, with an Addendum to the Gorgonacea" Monographie XIIIId of Uitkomsten op Zoologisch, Botanisch, Oceanographisch en Geologisch Gebied verzameld in Nederlandsch Oost-Indië 1899-1900 aan boord H.M. Siboga Leiden. E. J. Brill, Ltd). The authors have been assisted by Prof W R. Sheriffs (*Dendronephthya*), Miss Dorothy Chalmers (*Siphonogorgia*), and Dr J J Simpson (*Stereonephthya* and some related genera). Amongst the material are two new genera and fifty new species of the Alcyonacea, three new species of the Gorgonacea, and two new species of the Telestacea. Of much interest is the new species *Anthelia simplex*, a primitive form which is represented by a single polyp rising from a thick membranous base, having no calyx and very simple short pinnules, the whole surface of tentacles, body, and base being studded with minute blunt-ended rodlets. For another primitive form, previously described as *Coelogorgia repens* by Thomson and Henderson, the authors establish the new genus *Protodendron*. It is not possible to refer to all the peculiarly interesting new forms and old forms revised which are discussed, described in detail, and beautifully figured in this splendid volume, but the fact that a parasitic copepod has been found, probably for the first time, in an alcyonarian, must be mentioned. This occurred in *Xenia ashworthi*, a dimorphic species in which curious abnormal stunted tentacles were observed. The tip of the abnormal tentacle was bent round to the oral surface where a small swollen pocket was found. These swellings each contained a copepod, usually lying transversely across the pocket, and several carried egg sacs. The pocket cavity, was definitely continuous with the tentacle cavity, and the appearance of the pocket strongly suggested that it is simply an enlargement of the tentacle cavity at the tip into which the copepod has passed from the polyp.

**Vitamins in the Mango**—The mango is a fruit of very great importance to the inhabitants of the tropics, and might find a market in colder climates if conditions of transit, storage, and distribution could be adjusted. Its cultivation spread first from India to

tropical and subtropical America at present, it is gaining favour as a dessert fruit in North America. The vitamin A, C, and D content of certain varieties has recently been investigated by Perry and Zilva (Empire Marketing Board Preliminary Report on the Vitamin Content of the Mango. London H.M. Stationery Office 1s net). The fruit, which was transported at a temperature of 40°-50° F and then kept frozen at -20° C during the experiment, was tested for its growth-promoting power (vitamin A activity) on rats, for its antiscorbutic potency on guinea-pigs, and for its antirachitic effect on rats, comparisons being made in each case with cod-liver oil or lemon juice. The pulp of the three varieties examined contained about the same amount of vitamin A as butter. Two contained as much vitamin C as lemon juice, or even more the pulp or rind of the "Alphonso" variety was found to be a more potent source of vitamin C than lemon juice, containing about twice as much, while the pulp of the "Cawassi Patel" variety contained about as much vitamin as the latter. The "Shendrya" variety, however, contained much less and was about as potent as "Bramley's Seedling" apple. None of the varieties contained any significant amounts of vitamin D. Similar variations in vitamin C content between different varieties of the same fruit have already been noted in the case of apples (NATURE, 127, 75, 1931).

**Browning Root Rot of Cereals**—Farmers in the province of Saskatchewan have been troubled with a root rot of cereals sown after summer fallow. The rot was sufficiently extensive to nullify any of the beneficial effects on yield usually associated with fallowing. Many opinions and theories were prevalent amongst practical men as to the cause of the malady, but two members of the University of Saskatchewan have recently proved that species of *Pythium* are responsible ("Studies on Browning Root Rot of Cereals (II). Some Parasitic Species of *Pythium* and their relation to the Disease", by T. C. Vanterpool and J. H. L. Truscott, *Canadian Journal of Research*, vol. 6, No. 1, pp. 68-93, 1932). The account describes numerous field experiments, which show that the cause of the disease was present in the fallowed soil. From the numerous species of *Pythium* isolated from rotted roots, two, *P. arrhenomanes* v. *Canadensis* and *P. volutum*, were found which upon inoculation reproduced symptoms of the malady. *Pythium volutum* is a new species, and varies greatly in the degree of its parasitism. The present work has shown that the seed treatments previously used against browning root rot are quite unnecessary and, in fact, may aggravate the disease. Hydrogen ion concentration of the soil seems to have no effect upon the distribution of the pathogenic species of *Pythium*, which have actually grown on culture media more acid than any of the prairie soils examined.

**Fungi Pathogenic to Man**—The attention of medical men, mycologists, and others who are interested in fungi pathogenic to man is directed to an account by Mr. J. Ramsbottom, Keeper of Botany in the British Museum (Natural History), published by the Medical Research Council in vol. 8 of "A System of Bacteriology in Relation to Medicine" (London, 1931), and also available separately. After giving an outline of the classification of fungi and of some features of their biology (for example, polymorphism, pleomorphism, strains), the author proceeds to record in systematic sequence, beginning with the Phycomycetes, the fungi which have been described as causing disease in man. Many of these organisms are insufficiently described and their systematic position doubtful. The majority of the pathogenic forms are classed as Fungi Imper-

fecti, as the spore forms known do not include the sexual or perfect stage. The account concludes with a more detailed consideration of the ringworm fungi.

**Tectonic Analysis of the Mourne Mountains**—Dr. H. P. T. Rohleder has carried out a tectonic investigation of the Tertiary granite mass of the Mourne Mountains, applying the principles developed by Prof. Cloos of Bonn (*Proc. Roy. Irish Acad.*, 40, B, 12, 160-174, 1932). The pre-existing trend-lines of the Silurian country rock showed the way to the pre-granitic basalt dykes. These have been cut off abruptly by the granite which domed up the overlying strata to form a 'discordant laccolith'. During the phase of cooling, there came up quartz-porphry dykes and aplites, followed by basic veins representing post-plutonic pneumatolytic and hydrothermal activity. In the post-granitic phase, a second series of basalt dykes intersected the granite and the neighbouring Silurian rocks. Vertical joints can be traced in all the members of this complex. There are four dominant directions: a system of principal joints at 16° and 94° (measured clockwise from true north), and a system of diagonal joints at 50° and 149°. The quartz-porphry and aplite dykes follow mainly the 16° joints and to a less extent the diagonal directions. The 94° joints are avoided until all the other potential openings have been filled. Only the younger basalt dykes show an obvious majority in the 94° direction. Corresponding to these observations, the direction of best fissility of the granite coincides with the 16° direction. The latter is accordingly regarded as that of the 'open' cracks, and as the direction in which tectonic pressure was applied to the area during intrusion.

**An Irish Bog-flow**—Although bog-flows are comparatively rare events, a good many have been recorded in Ireland, particularly the famous Kerry flow of 1896. Few, however, are described in greater detail than the flow at Glencullin, Co. Mayo, in February 1931, of which Messrs. A. D. Delap, A. Farrington, R. L. Praeger, and L. B. Smith have recently published an account (*Sci. Proc. Roy. Dublin Soc.*, vol. 20, No. 17, 1932). This flow did much damage in destroying scanty arable land in the valley down which it swept for more than two miles. From a low ridge the flow suddenly started in peat about ten to twelve feet in thickness, until about 400,000 cubic yards had slipped down to the valley. At the first rush, the impetus was sufficient to cause the flow to rise on the opposite side some twenty-two feet above the valley floor. Immediately afterwards, the semi-liquid mass began to move down the valley. The harder, drier surface floated in the lower liquid bog as great floes or rafts. The flow was seen to advance like a wall down the valley. It carried stones and boulders with it. The writers of the report, in considering the cause of this flow, note a slight change in gradient where it began a little below a shallow tarn. The fracture was probably across the normal drainage of this tarn, and the lower layers of the bog were evidently in a saturated condition and without coherence. When the accumulation of water reached a certain amount, the 'burst' took place, and spread over the area of semi-liquid bog, ceasing where it reached drier under-peat.

**Variation of Hearing with Age**—There is a popular belief that hearing deteriorates with increasing age. In the *Bell Laboratories Record* for May, H. C. Montgomery describes a set of experiments made to determine the magnitude of this effect. The investigation was carried out with an audiometer on 200 employees in the laboratory, ranging in age from twenty to sixty.

years The audiometer produces any one of eight pure tones, varying in octave steps from a frequency of 64 to 8192 cycles These frequencies cover the useful hearing range and correspond to the *C*'s on the piano—omitting the lowest and adding one above the highest Measurements were made of the threshold of audibility at the various frequencies and diagrams were drawn These audiograms were divided according to age into four groups, each group ranging over ten years It was found that the difference between the thresholds of the youngest and oldest age group is quite small compared to the difference between the normal and those who have a difficulty in hearing In fact, at frequencies below 2000 cycles, the differences in the four groups are practically negligible At frequencies above 2000 cycles, the younger people hear the best In ordinary conversation, where speaker and listener are close together, this is not noticed In concert halls and theatres the effect is noticeable, some of the 50-60 group finding difficulty in distinguishing consonant sounds They thus mistake 'thin' for 'sin', 'famish' for 'vanish', etc The older group appreciate melody and rhythm as well as anyone, but the tones would sound more brilliant to youthful ears It is concluded that the average difference in hearing ability between twenty-five and fifty-five years of age is relatively small A further study including more advanced age groups might possibly discover marked differences in hearing ability

**Positive Ions of Mass 220**—L. L. Barnes and R. C. Gibbs announce, in a letter appearing in the *Physical Review* for April 15, that they have observed positive ions of mass 220 with a mass-spectrograph of the Dempster type The source of ions was a specimen of a mixed alkali sulphate, which was believed from X-ray analysis to contain a quantity of the missing alkali metal with atomic number 87 When heated in a high vacuum at a temperature of about 650° C, this gave rise to small but steady positive ion peaks in the mass-spectrum, a convincing example of which is reproduced The caesium ion currents from the same source at the same temperature were about ten thousand times greater, showing that the concentration of the heavier element is almost certainly only

minute The average value for  $m/e$  obtained from six curves was 220, with a maximum variation of not greater than one-half per cent, but a still more accurate determination of this quantity is being undertaken

**Spectra of Lead Isotopes**—The small differences in wave-length which were found more than ten years ago by Aronberg and Merton in the spectra of lead from different sources have been found by H. Kopfermann (*Z. Physik*, April 6) to come from differences in nuclear spin and hyperfine structure In the earlier work, this was not resolved, although the optical apparatus was of sufficient power, probably because of Doppler broadening of the lines on account of the high temperature of the source In Kopfermann's experiments, this is overcome by volatilising the metal in a gas discharge from a cathode kept cool by water or liquid air, and the hyperfine structure is readily observed The lines of uranium lead (206) and thorium lead (208) are all single and well separated, but the 207 isotope gives a more complex structure, the centre of gravity of which is intermediate between the terms of the lighter and heavier isotopes in the spark spectrum (Pb II) Kopfermann remarks that his results do not conflict with Schuler and Jones's discovery of a weak component of hyperfine structure, which they attribute to  $Pb^{204}$ , as they used much more intense sources

**Alchemical Manuscripts**—In the current number of *Archeion* (xiv, 1932, pp 57-61), Principal H. E. Stapleton publishes a preliminary account of the very important collection of Arabic alchemical manuscripts possessed by the Asafiyah Library of H. E. H. the Nizam of Hyderabad It appears that this collection comprises no fewer than 195 separate volumes, representing approximately 150 different treatises Twenty-two of the MSS are ascribed to Jābir ibn Hayyān, about a dozen to Aḍamir al-Jildakī, six to Muḥammad ibn Umayl (or Amyal), and three to Khālid ibn Yazīd, many other of the well-known Muslim alchemists also being represented Of considerable interest is the large number of works by previously unrecorded alchemical writers, which may be expected to yield valuable information when their study is undertaken Mr Stapleton promises a complete *catalogue raisonné* with as little delay as possible.

### Astronomical Topics

**Astronomical Notes for July**—Mercury is at its greatest elongation, 27° east of the sun, on July 20, but being south of the sun, it will only be seen with difficulty in the evening sky, it passes 2½° to the south of Jupiter on July 23 Jupiter is in conjunction with the sun on Aug 3, and is therefore too low for convenient observation in July Venus has become a morning star, but being still a thin crescent, it is not very conspicuous until the end of the month Saturn is in opposition on July 24, but its south declination of 20° makes delicate observations difficult There is only one occultation at a convenient hour, on July 10 the star  $\psi$  Virginis, of the fifth magnitude, disappears at 10 17 P.M. summer time, as seen from London No conspicuous comets are visible at the date of writing Ephemerides of periodic comets are given in the B. A. A. Handbook for 1932 Those who have suitable optical means should join in the search for Tempel's comet of the November meteors It will, however, be in a better position in a month or two

**Photography of the Full Moon**—Most photographers of the moon choose phases other than full for their exposures, in order to show the shadows, which aid in throwing the surface into relief Mr H. G. Tomkins, who has for many years made the moon his

special study, has lately taken a series of photographs of the full moon with the large reflector that he has erected at Dedham, Essex Ilford Astra plates were used with an orange filter, three prints from these plates are reproduced in *Monthly Notices* of the Royal Astronomical Society for April They were designed to bring out the contrast between the dark and the bright areas as strongly as possible, so that the maria are almost perfectly black and the brightest regions white But all through the bright regions there is a mottling of dark patches Mr Tomkins suggests that this dark eruptive rock forms a base extending over the whole surface of the moon, but overlaid in many places by some whiter material, pumice or volcanic ash are suggested, or possibly an efflorescence of some kind

The maria have some patches which are still darker than their general surface, it is shown that some of these are connected with the lava flows to which Mr. Tomkins directed attention in an earlier paper, they probably arise from an outpouring of dark lava on a surface that was already dusky

The paper also contains a study of the relative antiquity of various formations, thus the Mare Humorum is considered to have been the scene of comparatively late eruptions

## Vision

ON Friday, June 3, the Physical and Optical Societies held a joint discussion on vision at the Imperial College of Science, South Kensington. The meeting was divided into four sections, two in the afternoon and two after dinner. A discussion took place at the end of each group of papers forming a section.

The proceedings were opened by Mr J Guild, who in a general paper reviewed the scientific basis of vision. He pointed out that the retina is not the only factor concerned, for nerve tracts and endings in the central nervous system must also be considered. He stated that for colour vision there may be either three kinds of receptors with multiple central connexions, multiple sets of receptors with three groups of central connexions, or three sets of receptors with three groups of central connexions. The number three must come in because of the known facts of colour mixing.

Mr Guild also touched upon the problems of the nerve impulse and its relation to the intensity of a sensation, that is, if the nerve impulse is always of the same magnitude, is the intensity of sensation due to the frequency with which impulses follow each other up the individual nerve fibres? During the discussion it was stated that, from the physiological point of view, the intensity of a sensation depends upon the frequency of the nerve impulses, and that the more intense sensation, due to a larger area of stimulation, is related to the greater number of impulses in consequence of more nerve fibres being active.

Mr Guild also contributed a general paper dealing with the significance of measurements in visual work and with their mathematical treatment.

As might be expected, the word colour appeared in the titles of many of the papers and the subject of colour perception was discussed in many more papers, but other aspects of vision were also considered.

The more purely mechanical and optical aspects were dealt with in four papers. Prof A von Pflugk and Mr E F Fincham were concerned with the mechanism of accommodation. Mr Fincham believes that the lens is plastic and that its change in shape is due to the elasticity of the lens capsule. Presbyopia is due to increased rigidity of the plastic constituents of the lens. Prof von Pflugk contended that the zonule of Zinn is not responsible for the shape of the lens, but that the pressure of the vitreous with unslackened zonule produces the change in shape. The last word on this subject has not yet been said.

Prof C E Ferree and Dr G Rand presented a paper on the refractive conditions for the peripheral field of vision, in which the results of the examination of the eyes of twenty-one individuals were reported. Prof F Roessler described the method of testing for astigmatism by combined red and blue lights.

Visual acuity formed the subject of two papers. Dr R S Creed discussed the relationship of the retinal rods and cones, the nerve paths, and the frequency of impulses to visual acuity. Prof H Hartridge described the effects of chromatic aberration on the distribution of colour in the image of a point source of light.

The fundamental process whereby light stimulates the receptors in the retina was considered by Mr D Roaf. He showed, on the assumption that an increase in sensation denotes a definite quantity of decomposition of photochemical substance, that the acuity data of Houston agree with a bimolecular reaction for the synthesis of photosensitive material, but that the results will not fit the curve for a monomolecular reaction.

Prof A Bruckner presented a paper showing different rates of adaptation in a number of individuals

for whom the curves can be grouped into several classes. The condition of adaptation was mentioned by a number of speakers. Prof L C Martin wished to know whether the dark or light adapted condition were the simpler to work with. Prof H E Roaf agreed with Prof Martin that the dark adapted condition was simpler, but Dr R A Grant considered that the difficulty of accurate fixation makes the dark adapted condition more uncertain for experimental purposes. The condition of adaptation, that is, whether it is the result of diffuse illumination of neighbouring portions of the retina or whether it is due to the light shining on the same part of the retina as the test light, was not specifically discussed. From some points of view, Mr W D Wright's paper, "The Significance of Colour Fatigue Measurements", Dr R A Houston's on "New Observations on the Weber-Fechner Law", and Prof H E Roaf's communication were dealing with aspects of adaptation to light, as they described changes in sensitivity due to previous or simultaneous illumination of the eye. Messrs W S Stiles and B H Crawford measured the change in sensitivity due to extraneous light sources by finding out the illumination of the background or surrounding fields which produces the same alteration in visual threshold. They use this alteration in threshold as a measure of retinal adaptation.

The colour triangle received attention from two points of view. Prof J Drever presented results of estimations of the wave-length of 'pure' colours at varying intensity, showing that at 4710, 5080, and 5680 Å the colours appear pure even with marked differences in intensity. Prof Drever then pointed out the inadequacy of the colour triangle as a means of representing all colour sensations, including variations in brightness and saturation.

Mr T Smith dealt differently with the colour triangle. He folded it up, opened it out as a straight line extending to infinity, and brought it back as a much improved triangle in which variations in wave-length discrimination throughout the spectrum are of no significance.

The presence and number of different kinds of receptors (whether these depend on retinal conditions alone or beside the point) was considered from a number of aspects. Mr J Guild gave some sound generalisations as to what is implied and what is not implied by the Young-Helmholtz or trichromatic theory. His view does not entirely agree with that expressed by Prof W Peddie. Prof F Allen and Prof S Hecht each presented long papers. The former pointed out that his well-known observations by the flicker method can all be explained on the trichromatic theory. In the subsequent discussion, it was pointed out that the duration of the dark period cannot be assumed to depend only on the sensitivity of the eye, even when the intensity of the light is kept constant. Prof Hecht repeated his description of alterations in the sensation curves so that they form three almost identical curves. It did not seem reasonable to some of the participants that such closely similar curves could be a satisfactory basis for colour discrimination. Prof H E Roaf presented evidence in favour of there being three sets of receptors, one for the whole visible spectrum, one for red and green, and one for red alone. Absence or diminished specificity of the last would account for the ordinary defects in colour vision.

Various experimental papers were contributed, all of which will be useful in the final interpretation of the processes involved in colour vision. Prof L C Martin, Mr F L Warburton, and Mr W J Morgan

presented the results of observations on the number of recognisable steps between white and the spectral colours. There are fewer steps between green and white than between either red or blue and white. There are about an equal number of steps between either red or blue and white. This result agrees with the appearance that green has of being a less 'intense' colour than red or blue.

Prof H Hartridge described colour perception in an ivory white light formed by removing all the rays less than 5300 Å and some of the red. By such a light, it is possible to recognise pigmentary colours, but yellows are too pale, blues too dark, and purples too red. Ishihara's tests can be passed by a normal individual in such a light. These results indicate that the receptors for blue are probably stimulated by wave-lengths other than those less than 5300 Å.

Prof H Pieron's paper dealt with the time necessary for the production of colour by stimuli of short duration. For red the time is 95 σ, for green 105 σ, and for blue 120 σ, thus showing the slower response for receptors for blue.

There were five papers which dealt with the problems of interpretation of visual stimuli. Dr L F Richardson has obtained estimates of the relative amount of red in a given sample of colour, and finds that different individuals show an agreement between their estimates of the relative proportions of red and white in the mixture.

Prof F C Bartlett sent in a paper dealing with the visual perception of depth, and Mr H Bannister offered an explanation of Pulfrich's pendulum experiment. Prof Koffka described the phenomena concerned with contrast in the black-white series, and based a general theory of vision on the results.

Dr R A Granit enlarged upon the significance of the synapses in the retina in relation to the path of

the impulses proceeding through the retina to reach the optic nerve cells and fibres.

By the system of limiting each speaker to eight minutes, all the papers were disposed of in time to allow of discussion. As the authors did not reply to criticisms, we must await the publication of the whole discussion in order to know the final decision on some points. It might have been better if the papers had been grouped under subjects, though that is almost impossible, because so many of the subjects overlap, and until the papers have been read it is not easy to know under which subject to classify them.

Amongst the points brought out during the discussion are the following. It seems clear that vision is to be explained on a trichromatic basis. The actual wave-lengths that stimulate the different kinds of receptors are not yet determined. There is no certainty as to the relation between total brightness and the brightness due to the individual receptors. Even such a mechanical process as the change in shape of the lens during accommodation is not beyond the sphere of active controversy, so it is not to be expected that the more recondite processes of visual perceptions will be agreed upon with equanimity.

The discussion was undoubtedly successful and a worthy successor to the one held a year ago on audition. With all the papers but one in print, the authors had only to refer to the salient points.

Unfortunately, Sir John Parsons was unable to attend and to open the proceedings. Mr Guild undertook that duty at the eleventh hour, hence his opening remarks were not in print. From what one can recollect of them, the printed paper will be a valuable contribution to the philosophy of vision and a guide to future makers of hypotheses. All those interested in vision will look forward to the publication of the discussion in full.

### Research Defence and Anti-Vivisection

THE Research Defence Society was founded in 1908 by the late Stephen Paget. It was the outcome of the Association for the Advancement of Medicine by Research and Prof Starling's Committee which collected and presented evidence for medical and scientific research before the Royal Commission on Vivisection which sat in 1906-8. That Commission probed the anti-vivisection question to the depths, but declared in favour of research work under the Act of 1876, which has controlled the use of animals for experimental purposes in England for more than half a century. In spite of this rebuff, anti-vivisectionists have continued to attack research workers and their institutions, even those who are engaged on veterinary research. The Research Defence Society undertook to inform the public of the conditions under which animals are used, the need for the work, and the alleviation of human and animal suffering which has resulted from such work.

The Annual Report of the Society for the past year pays a glowing tribute to the work and devotion of the late Lord Knutsford, who had been chairman since 1908. The Hon Sir Arthur Stanley, chairman of the British Red Cross Society, succeeds Lord Knutsford as chairman of Committee, and Prof A V Hill has accepted the office of vice-chairman formerly held by Mr Stephen Paget, while the following have become vice-presidents of the Society: Mary Viscountess Knutsford, Mrs F M Sandwith, Lord Moynihan, Sir Frederick Gowland Hopkins, Sir Walter Fletcher, Sir Alfred Beit, Sir Henry H Dale.

During the year under review, an event of outstanding importance was the final judgment of the Court of Appeal and the Order of the House of Lords

in regard to the will of the late Mrs Sarah Martha Grove-Grady, who left her residuary estate, amounting to approximately £200,000, to found and endow a new anti-vivisection organisation. If this bequest had been held to be charitable, a slur would have been cast on medical and veterinary progress by research and on institutions registered under the Act of 1876, for the conditions she laid down even precluded the Royal Society for the Prevention of Cruelty to Animals from accepting any of her money, because it could not be said that all members of the governing body of that Society were confirmed anti-vivisectionists. Largely as a result of the endeavours of the Research Defence Society, the Court of Appeal reversed the decision of a lower court which had upheld the will, and an Order of the House of Lords finally settled the case by ruling that £25,000 out of the residuary estate should be devoted to the benefit of animals, provided that none of the money were used for anti-vivisection propaganda. The Research Defence Society urged that this money should be given to the Royal Veterinary College (which had been attacked by anti-vivisectionists), with the gratifying result that the whole of the sum has now been allocated to that institution for the purposes of building and endowing an animals' hospital.

The annual general meeting of the Society took place on June 3, in the lecture hall of the London School of Hygiene and Tropical Medicine. Lord Lamington, the president, took the chair, and Sir Arthur Keith delivered the sixth Stephen Paget Memorial Lecture on "Some Aspects of the Modern Conflict between Sentiment and Reason."

Sir Arthur opened by contrasting physical and



physiological research, pointing out that whereas the physicist has to satisfy only a scientific ideal, the physiologist has to confront an ethical as well as a scientific standard. "The conflict between sentiment and reason, as carried on to-day, finds its sharpest expression in the opposition offered to the beneficial work carried on by experimental physiologists. This society—the Research Defence Society—rightly concentrates its efforts on the vindication of the work carried on in our physiological laboratories. The anti-vivisection crusade is dangerous and has to be repelled, but after all, it is only an acute manifestation of a conflict which permeates modern society—a conflict in which blind sentiment is ranged against clear reason."

In dealing with the conflict between economic needs and sentiment, Sir Arthur pointed out the difference in the conditions when our ancestors hunted for their food and modern times when animals are deliberately bred for the butcher. We have to recognise by force of reason our economic needs, or, if sentiment becomes too strong, we must forswear all forms of animal meat. He continued, "It is not sentiment but reason which must be the final arbiter in the attitude we are to adopt to our four-footed dumb friends."

Discussing the problem of cruelty, Sir Arthur said, "The vice of cruelty has been given to man for the same reason as a sting has been given to the wasp and thorns to the rose—namely, for protection—to make their enemies afraid of them." In its primitive form it is a vice of hot blood, thoughtless cruelty, on the other hand, is a prevalent failing which everyone would wish to see eliminated. The most terrible form of cruelty is that which wilfully seeks to misinterpret motive. While there is need for a society to save animals from unnecessary suffering, there is still more need for a society, such as the Research Defence Society, to save scientific men from the cruelty of misrepresentation and of injustice.

Critics of research on animals have based arguments on so-called common sense, but as Sir Arthur pointed out, "When 'common sense' comes against expert knowledge, retreat is the wiser policy. Darwin's victory was one over the 'common sense' of his age. In the recondite fields of medicine, especially in the basal science of physiology, we must be prepared to be guided not by common sense but by the argument of irrefutable fact. We can hardly expect the man in the street, who has his own preoccupations, to know all that special experience has vouchsafed to us. If research is to prosper, the great public must be kept informed of its aims and accomplishments."

Sir Arthur then paid an eloquent tribute to the work for animals carried out by the Royal Veterinary College, and condemned emphatically the anti-vivisectionists who had attempted to frustrate the appeal of that institution for funds.

### University and Educational Intelligence

**BIRMINGHAM**—Applications from holders of an honours degree in engineering of a British university are invited for the James Watt Research Fellowship in Mechanical Engineering, the annual value of which is about £250. They should reach the Registrar of the University by, at latest, July 11.

**CAMBRIDGE**—The John Humphrey Plummer professorship of inorganic chemistry has been established, and the electors will meet on July 18. The stipend of the professor is £1200 a year or, if he holds a fellowship with dividend, £1000 a year. Candidates are requested to communicate with the Vice-Chancellor on or before July 7.

Applications for the Gwyneth Pretty Studentship, the holder of which shall devote himself to original research in the etiology, pathology, and treatment of disease, with particular but not exclusive reference to those diseases which cripple or disable in childhood or early life, are invited, and should be sent before July 30 to Prof H. R. Dean, Department of Pathology. The studentship is of the annual value of £200 and is tenable for three years.

The Lucasian professorship of mathematics will be vacated by Sir Joseph Larmor on Sept 30. A meeting of the electors will be held on July 25. The stipend of the professor is £1200 a year or, while the professor holds a fellowship of a college with dividend, £1000. Candidates for the professorship are requested to communicate with the Vice-Chancellor on or before July 11.

Dr W. H. Thorpe, of Jesus College, has been appointed University lecturer in entomology. Mr. B. H. C. Matthews, of King's College, has been appointed assistant director of physiological research.

APPLICATIONS are invited by the Royal College of Physicians of London for two Leverhulme research scholarships, each of the annual value of £500, for the investigation of some clinical problem of disease as it occurs in man. Applications must be sent before July 4 to the Registrar, Royal College of Physicians, Pall Mall East, S.W. 1.

THE Science Scholarships Committee of the Royal Commission for the Exhibition of 1851 has made the following appointments to Senior Studentships for 1932, the name of the recommending university being given in brackets: Dr S. Tolansky (Durham), for research in physics; Mr R. S. Alcock (Cambridge), for research in biochemistry; Mr S. H. Bastow (Cambridge), for research in physical chemistry; Mr. H. D. Ursell (Cambridge), for research in mathematics; Dr E. A. Moelwyn-Hughes (Oxford), for research in physical chemistry; Dr R. D. Preston (Leeds), for research in botany.

ELEMENTARY education in the United States of America is reviewed in *Bulletin* No. 20, 1931, of the Office of Education, Washington, consisting of advance pages of the official biennial survey for 1928-1930. Widespread appreciation of the conception of learning as an active rather than an absorptive process has led to notable improvements in equipment, courses, and instructional materials providing for constructing, illustrating, dramatising, modelling, and many other forms of creative activity. Elementary school aims have shown progressive enlargement of scope so as to include, in addition to the traditional function of instruction, the promotion of physical, recreational, educational, and social welfare outside the regular school day, as is evidenced by the creation of new posts such as home visitor, social care worker, after-school recreational director, and director of parent educational activities, and also by the linking up of school work with libraries, clubs, juvenile courts, Red Cross works, and community clinics. The instructional possibilities of radio and sound films have been receiving close attention. There has been a movement towards requiring a certain minimum standard of special qualifications when selecting school librarians, teachers of elementary school science, literature, and social studies. Finally, much ingenuity has been devoted to the elaboration of courses of study for pupils of different learning, interests, difficulties, or capacities.

## Calendar of Geographical Exploration

June 26, 1843.—The Wady Hadramaut

Adolph von Wrede started his journey inland from Makalla on the Gulf of Aden, and succeeded in crossing the barrier maintained by the sheikhs of the coast towns between long  $46^\circ$  and  $52^\circ$  for so long against foreigners. Disguised as a Mohammedan, he penetrated to the Wady Doan and ultimately reached the great sands of the Ahkâf, where he found that a sixty-fathom plumb line disappeared completely in the sands. He did not reach the main wady of the Hadramaut proper, but his journey established the general character of the fertile Hadramaut country as a system of branching valleys, deeply sunk in a high plateau and debouching into the great Wady Hadramaut Channel.

June 28, 1819 — Crossing Arabia from Sea to Sea

Capt G F Sadlier started on a mission which resulted in the first crossing of Arabia from sea to sea by a western European. He went to Hofuf in the Hasa Oasis, entered Nejd by the province of Yemama, passed south of Riyadh, and reached Anseiza. He arrived in the suburbs of Medina, but was not allowed to enter the Holy City itself, being banished to Bir Ali. There at last he had audience of Ibrahim, but Sadlier could come to no agreement with the Egyptian pasha. The British envoy and his party reached the Red Sea on Sept 20. Sadlier took many compass readings, recorded the names of all settlements which he passed or saw, and gave notes of the time occupied on each march. He also recorded many details relating to trade and transport, to the character of the settlements along his route, and to the type of cultivation of the soil. For the first time, medieval information about the peninsula was checked by actual survey.

June 29, 1871 — Route to the Polar Sea

C F Hall, in command of the United States North Polar Expedition, left Brooklyn in the *Polaris*. In 1860–61, I I Hayes had explored Ellesmere Island, between lat  $77^\circ$  and  $78^\circ$  N, and had reached Kennedy Channel, which he mistook for the open polar sea. Hall's voyage in the *Polaris*, when he reached  $82^\circ 26'$  N, was a result of the hopes raised by Hayes, and it finally showed the route to the polar sea, though Hall himself was taken ill and died while exploring Greenland. Hall made his first voyage in 1860, when, though his vessel was wrecked, he made a two and a half years' exploration by sledge and boat off Frobisher Bay, and Countess of Warwick Sound, returning with charts and with descriptions of native life. In 1864, Hall again set out to try to obtain news of Franklin's fate. After spending five years in the search, he returned convinced that there was no survivor of Franklin's party, and bringing back with him many relics of the Franklin expedition obtained from the natives.

July 1, 1648 — An Early Discovery of Bering Strait

A Cossack, Dezhnev, started from the Kolyma River on an exploring expedition, undertaken with the approval of the Russian Government, partly to discover islands in the polar sea which had been reported by hunters, and partly to increase the territory paying tribute to Russia. Dezhnev rounded the north-east point of Siberia apparently in open water, though he remarked that this sea was not free from ice in every year. He continued his voyage down the east coast of Kamchatka, and reached the mouth of the Anadyr River in October. The record of his voyage was long forgotten, but papers discovered concerning a quarrel

between him and a companion about the right of discovery to a walrus bank on the east coast of Kamchatka brought it to light. The Russians have renamed East Cape as Cape Dezhnev in his honour. These Cossack journeys in the polar seas are the more remarkable because the vessels they used were small rowing boats, only using sail in a fair wind, and were often caulked with moss mixed with clay and held together with willows. The strait between Siberia and America, through which Dezhnev had passed, did not become known until Bering's voyage in 1729.

July 1, 1906 — Grenfell on the Congo

George Grenfell died at Basoko. Grenfell began his geographical work in 1874, when he explored many of the navigable tributaries of the Congo. In 1884 he made a survey of the Congo up to the equator in long  $18^\circ$  E, and in 1885 ascended the Ubanga to the Zongo Falls. Later he explored the Aruwimi River, reaching Mawambi in November 1902. His work and that of von Wissman first elucidated the drainage of the Congo basin.

## Societies and Academies

### LONDON

Geological Society, April 27 — W F Whittard. The stratigraphy of the Valentian rocks of Shropshire: the Longmynd-Shelve and Breidden outcrops. A dual division of the Valentian rocks of Shropshire into a lower group, the Pentamerus beds, and an upper group, the Purple shales, was adopted. Further, two lithological subdivisions of the Pentamerus beds, the Arenaceous phase and the Mudstone phase, were recognised. The Longmynd-Shelve outcrop is divided into several areas by glacial deposits. The rocks of these areas exhibit different lithological and faunal characters, due to the variable conditions under which they were laid down. Two distinct faunas characterise the Valentian rocks of the main outcrop, and these were selected as the standard faunas. Several local modifications of each standard fauna are present in the Longmynd-Shelve and Breidden outcrops. The character of the sea-bed and the control it exerted on the kind of fauna which frequented a particular area were stressed, and attention was directed to the mud- and sand-loving genera and species. The encroachment of the sea over the district in Upper Valentian times resulted in a complicated region of land and sea to which the name of 'Salopia' was given.

### DUBLIN

Royal Irish Academy, April 25 — A W Conway. The radiation of angular momentum. The application of classical electrodynamics to the general problem of the radiation of angular momentum from an oscillating system of  $n^{\text{th}}$  order with  $4n+2$  amplitudes. Components of type  $\frac{sh}{2\pi}$  and  $\frac{1}{2}\sqrt{n(n+1)-s(s+1)}\frac{h}{2\pi}$  are obtained and an energy term of type  $\{n(n+1)-s^2\}\frac{h^2}{8\pi I} + Dn^2(n+1)^2$  — A W Conway and A J McConnell.

The determination of Hamilton's principal function. Hamilton's great contribution to dynamics was his discovery of his *principal function* by means of which he was able to bring dynamical theory under one central principle. He showed that the function satisfied two partial differential equations, but he failed to give any account of how it was to be formed other than by direct integration of the equations of motion. Jacobi's contribution consisted in showing that the paths of the dynamical system could be obtained from

a complete integral of the first of Hamilton's differential equations. The present paper completes the theoretical aspect of this question by describing a method of forming the principal function directly from a Jacobi complete integral.

## PARIS

Academy of Sciences, May 9.—J. Costantin. The importance of the mosaic disease of the sugar cane from the point of view of degenerescence. Sugar canes raised in the mountains in Java are resistant to the disease and this has been confirmed by experiments in the Dutch West Indies.—M. de Broglie and L. Leprince-Ringuet. The dispersion of the neutrons of beryllium and the existence of recoil nuclei caused by excited lithium.—Charles Nicolle and Charles Anderson. A new proof of the individual specificity of the spirochaetes of recurring Spanish-African fever. A reply to criticism by Delanoe. Further experiments are described proving that the results do not depend on the dose of the virus.—A. Yersin. Long survival of *Hevea* trees broken by a typhoon. Some of the plants, broken by the typhoon at heights of 1.2 metres from the soil in November 1926, are still alive. Although without leaves, they still produce latex in practically the same proportion as the uninjured plants. The rubber produced from this latex is normal.—Henri Buisson was elected *correspondant* for the Section of General Physics in succession to the late R. Blondlot.—Pierre Boos. The relation which exists between an arc of a curve and the angle under which it is seen from its origin.—Michel Fekete. Some generalisations of Jensen's inequality.—J. Leray. Certain classes of non-linear integral equations.—Vladimir Bernstein. The analogy between the distribution of the straight lines of Julia of holomorphic functions and that of the singular points of analytical functions.—P. Lejay and R. Goudey. Measurements of gravity made with the No. 2 Holweck-Lejay apparatus. The results of measurements made at 17 stations in France are given and a reduction formula worked out.—Albert Perard. A new line as a light wave standard of length. Instead of the green-yellow krypton line (5649), which is not very bright, the krypton line 5562 is suggested.—Jean Galibourg. The elastic limit of extra mild steel drawn out into wire. A study of the effect of keeping at the ordinary temperature.—Georges Vaudet. A vacuum contact breaker for high tension currents.—Raymond Dubois and Louis Laboureur. A direct reading electric chronograph allowing the exact measurement of very short time intervals.—Marcel Cau. The variation with the thickness of the magneto-optical effects by transmission through thin layers of iron.—Ny Tsi-Ze and Chien Ling-Chao. The photographic effect of pressure. If  $E$  is the illumination producing a density  $d$  when the emulsion is under a pressure  $p$ , and  $E'$  the illumination which produces the same density when the emulsion is submitted to no pressure, the ratio  $E/E'$  depends only on the pressure  $p$ . Above a certain pressure, 200 kgm/cm<sup>2</sup> for one plate used,  $E/E'$  is a linear function of  $p$ .—Jean Thibaud and F. Dupré la Tour. The penetrating power of the radiation (neutrons) excited in beryllium by the  $\alpha$ -rays. The neutrons from beryllium appear to be much more penetrating than would appear from the figures already published. Thus after passing through a screen of 30 cm of lead, one-tenth of the incident radiation remains. The absorption resembles that of a heterogeneous radiation, of which each constituent follows an exponential law.—Desmaroux. The mechanism of the decomposition of the nitro-celluloses. The experiments described lead to the conclusion that the principal phenomenon in the decomposition of the nitrocelluloses by heat, at least

in the first stage, is the destruction by a partial combustion of one of the residual glucose rings, followed by a break in the chain.—Mile Choucroun. Selective permeability and polarisation of membranes.—Felix Trombe. The preparation of metallic lanthanum free from iron and silica. The electrolyte was a mixture of lanthanum chloride, potassium chloride, and calcium fluoride. The cathode was molybdenum, and the deposited metal was collected in a crucible of fluorspar or silica. The metal was spectroscopically free from calcium and aluminium, and when collected in fluorspar contained less than 0.05 per cent silicon.—E. M. Bellet. The mechanism of the reaction of esters in the presence of alcohol in weakly alkaline medium.—L. Capatos. Some combinations of arsonium bases.—Ch. Courtot, M. Chaix, and L. Nicolas. The preparation of diphenylene sulphide. Study of Schonberg's method, the interaction of diphenylsulphonone and sodium amide, leading to a higher yield and to the isolation of some secondary products.—Mme Bruzau. The action of parabromanisylmagnesium on dimethylphenylacetamide.—Charles Dufraisse and Maurice Loury. Researches on the dissociable organic oxides. Three isomeric dimethylrubrenes,  $C_{44}H_{32}$ . Their dissociable oxides.—L. Domange. The action of heat on fluorspar. The luminescence produced by heating fluorspar crystals is not in any direct relation with a loss of material. It occurs when the crystals are broken.—Maurice Blumenthal. The structural elements of the Bokoya (Eastern Spanish Rif).—Marcel Thorat. A new contribution to the stratigraphy of the Cambrian and Silurian in the eastern part of the Monts de Lacenne.—G. Debebant. The kinematics of the isobaric centres.—Chadefaud. The physodes of the Pheophyceae.—Marc Simonet. The cytological study of the Pogoregelia hybrid, *Iris obiensis*  $\times$  *Iris Korolkowii*.—H. Colin and E. Bougy. The structure and richness in sugar of the hybrids of the beetroot.—Jan Hirschler. Certain membranous and granular plasmatic components in the male sexual cells of the Lepidoptera.—L. Lutz. The soluble ferments secreted by the Hymenomycetes fungi. The ketones, the anthraquinonic bodies, and the anti-oxygen function.—G. Stodel and A. Bourdin. The relation between the toxic power and the antigen power of the diphtheric toxins.—A. and R. Sartory, J. Weill, and J. Meyer. A case of blastomycosis of long standing transmissible to the guinea-pig due to a pathogenic *Saccharomyces* (*S. Jadini*).—Joseph Lignières. The determination of the types of aphthous virus.—Marcandier and Robert Pirot. The transmission from man to the guinea-pig (after passage through the rat) of the Toulon typhus virus (mild endemic typhus of warships).—E. Roubaud. The trophic strains of *Anopheles maculipennis* detected by comparative experimental cultivation.

## ROME

Royal National Academy of the Lincei, Jan. 3.—G. Fano. Birational transformations on algebraic varieties of three dimensions.—E. Paternò. (1) Action of sodium carbonate on cellulose. After immersion for three hours in water at the ordinary temperature, celluloses of various origins lose 0.5 per cent of their weight, this loss being doubled at 50°. The extents to which water and sodium carbonate solution are absorbed at 10°-12° may be taken as identical and as characteristic of the particular cellulose. For various sulphite wood-celluloses and for cellulose prepared by means of chlorine from straw, esparto, and hemp, such absorption varies from 98 to 152 per cent, the absorption seems to consist of simple imbibition due to the porosity. Cellulose containing relatively large proportions of  $\gamma$ -cellulose and pentosans (esparto

cellulose) is not suitable for the preparation of viscose, but preliminary treatment with sodium carbonate may be of use in such a case—(2) Exhausted cellulose. Cellulose which has been treated with sodium hydroxide solution—so-called exhausted cellulose—is a form of pure cellulose. Certain of the products known collectively as hemi-cellulose, whether pre-existent or not in wood, are formed also by the action of the air, the action being enhanced by the presence of water or salts, and to a greater extent by that of alkali—(3) Oxycellulose and its identity with  $\beta$ -cellulose and cellodextrin—L Cambi and G Devoto. The action of certain organic substances in the electrolytic deposition of zinc—Vladimiro Bernstein. The growth of holomorph functions of exponential type—G Lampariello. An equation of the partial derivatives of the fourth order—N Obrechko. A generalisation of Borel's summation of divergent series—P E Brunelli. Certain singular values of the critical velocities of shafts—A de Mira Fernandes. Zermelo's brachistochrone problem—Ioan I Placinteanu. The equations of the movement of three bodies of variable mass—G Viola. Certain peculiarities of the annual variation of relative humidity. In Italy, as throughout Europe generally, the relative humidity follows a law of variation opposed to that of the temperature, the minimum temperature corresponding with the maximum of humidity and vice versa. The results obtained at certain observatories do not, however, accord with this law, and are influenced, not only by the temperature, movement of the air, rainfall, etc., but also by the topographical position and by the frequency of wind. This is particularly the case at Gaeta and Chiavari, and the same would doubtless be found at other coastal stations—B Rossi. Calculation of the action of the terrestrial magnetic field on a corpuscular radiation generated in the atmosphere. The negative results of experiments made with the object of showing an action of the earth's magnetic field on the intensity distribution of penetrating radiation are usually regarded as a proof that the primary penetrating radiation is an ultra- $\gamma$  radiation, which generates in the atmosphere the corpuscular radiation revealed by the apparatus used. Consideration of this question leads to the conclusion that the corpuscular radiation observed cannot be the secondary radiation of a  $\gamma$ -radiation. Experiments on the subject are in progress—R Bruscaioni. The form of the interference fringes obtained from waves affected by pure astigmatism with gratings at any orientation—Paolo Straneo. The unitary theory of gravitation and electricity (4) Discussion and improvement of the earlier theory—G Piccardi and A Sberna. Molecular spectra and spectroscopic analysis (2) Investigation of lanthanum. From the qualitative point of view, the molecular spectrum method shows a sensitiveness equal to that of the spark spectrum method in the case of lanthanum. For low concentrations and in presence of elements of complicated spectra, it permits of more certain identification. For the concentration of lanthanum in solution, this method gives results of an accuracy corresponding with that shown by optical methods—L Mascarelli and D Gatti. Diphenyl and its derivatives (11) New derivatives of 2-methyldiphenyl and the influence of the methyl group on the reactions of an amino group in the 2'-position. The results of experiments on 2-methyl-2'-aminodiphenyl show that the hypothetical closure—by means of NH, O, or I—of a third nucleus at the 2-2' or 2-6' position never occurs, this indicating that the union between carbon atoms is stronger than that between other elements. Not only is the 2-methyl group not displaced, but it does not disturb any of the reactions of the 2'-amino group—G Natta.

and R Pirani. Solid solutions by precipitation and isomorphism between complexes of quadrivalent tellurium and platinum (1) Structure of caesium and rubidium chloroplatinates. These compounds form cubic crystals of the space-group  $Oh^8$ . The unit cell contains four molecules and has the side  $10.15 \pm 0.01$  Å for the caesium and  $9.83 \pm 0.01$  Å for the rubidium compound, the respective densities are 4.25 and 4.04. Calculation of the structure factor shows that the parameter  $u$  which defines the position of the chlorine ion has the value of about 0.23-0.24 for the caesium compound—C Sandonini. Transpositions in the benzene nucleus (1)

## Forthcoming Events

### SATURDAY, JUNE 25

BRITISH PSYCHOLOGICAL SOCIETY (General Meeting) (at National Institute of Industrial Psychology, Aldwych House, Aldwych, W C 2), at 3—Dr J W Cox. An Experimental Enquiry into the Effects of 'Practice', and of 'Training', in Manual Operations—B Babbington Smith. A Critical Examination of Recent Work on Perseveration.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (Annual Provincial Meeting) (at Alton)

JOURNÉES MÉDICALES DE BRUXELLES (at Brussels) (continued on June 26 to 28)

### TUESDAY, JUNE 28

NATIONAL PHYSICAL LABORATORY, TEDDINGTON, at 3—Meeting of the General Board of the Laboratory

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30—Capt T A Joyce. The 'Eccentric Flints' of Central America (Presidential Address)

### FRIDAY, JULY 1

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7.30—Dr T Neville George. The Superficial Deposits of the South Coast of Gower—Dr A W Groves. The Geology of Uganda, B E A, with special reference to the Tectonics (Lecture)

## Official Publications Received

### BRITISH

The Imperial Council of Agricultural Research. Scientific Monograph No 1. The Fungus of India. By Dr E J Butler and Prof G R Bisby. Pp viii+237. (Calcutta: Government of India Central Publication Branch.) 5 12 rupees, 11s.  
Journal of the Royal Statistical Society. New Series, Vol 95, Part 2. Pp viii+185 394. (London: Royal Statistical Society.) 7s 6d.  
Transactions of the Institute of Marine Engineers, Incorporated. Session 1932. Vol 44, No 4, May. Pp 167 218+xxvi. (London.)  
Transactions of the Royal Society of Edinburgh. Vol 57, Part 1, No 8. The Development of the Sorus in some Species of Nephrolepis, together with some Observations on points of Anatomical Interest. By Dr Isobel M Case. Pp 259 276. (Edinburgh: Robert Grant and Son, London: Williams and Norgate, Ltd.) 2s 3d.

### FOREIGN

Smithsonian Institution. Bureau of American Ethnology. Bulletin 105. Notes on the Fox Wapanawiwani. By Truman Michelson. Pp v+195. 35 cents. Bulletin 107. Karuk Indian Myths. By John P Harrington. Pp v+34. 5 cents. (Washington, D C: Government Printing Office.)  
University of California Publications in American Archaeology and Ethnology. Vol 31, No 2. The Northfork Mono. By E W Gifford. Pp iv+15 65+16 plates. (Berkeley, Calif: University of California Press.) 1 25 dollars.  
The Academy of Natural Sciences of Philadelphia. 1931 Year Book. Pp 62. (Philadelphia.)

### CATALOGUES

Liver Extract B D H. Pp 11. (London: The British Drug Houses, Ltd.)  
Società di Esportazione Polenghi Lombardo Industria del Latte. Pp 256. (Lodi.)  
Catalogue of New Books of all Publishers on Physics and Mathematics. Pp 26. (London: H K Lewis and Co, Ltd.)  
Ornithology (New Series, No 28). Pp 56. (London: Wheldon and Wesley, Ltd.)  
Sotheran's Bibliotheca Chemico Mathematica. Catalogue of Works in many Tongues on Exact and Applied Science. First Supplement. Pp xii+490. (London: Henry Sotheran, Ltd.) 10s 6d net.